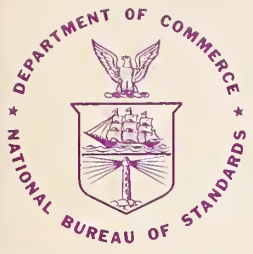


NBS SPECIAL PUBLICATION 305
SUPPLEMENT 5

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

# PUBLICATIONS

## OF THE NATIONAL BUREAU OF STANDARDS

## 1973 CATALOG

## NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards [1] was established by an act of Congress March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau consists of the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Institute for Computer Sciences and Technology, and the Office for Information Programs.

**THE INSTITUTE FOR BASIC STANDARDS** provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of a Center for Radiation Research, an Office of Measurement Services and the following divisions:

Applied Mathematics — Electricity — Mechanics — Heat — Optical Physics — Nuclear Sciences [2] — Applied Radiation [2] — Quantum Electronics [3] — Electromagnetics [3] — Time and Frequency [3] — Laboratory Astrophysics [3] — Cryogenics [3].

**THE INSTITUTE FOR MATERIALS RESEARCH** conducts materials research leading to improved methods of measurement, standards, and data on the properties of well-characterized materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; and develops, produces, and distributes standard reference materials. The Institute consists of the Office of Standard Reference Materials and the following divisions:

Analytical Chemistry — Polymers — Metallurgy — Inorganic Materials — Reactor Radiation — Physical Chemistry.

**THE INSTITUTE FOR APPLIED TECHNOLOGY** provides technical services to promote the use of available technology and to facilitate technological innovation in industry and Government; cooperates with public and private organizations leading to the development of technological standards (including mandatory safety standards), codes and methods of test; and provides technical advice and services to Government agencies upon request. The Institute consists of a Center for Building Technology and the following divisions and offices:

Engineering and Product Standards — Weights and Measures — Invention and Innovation — Product Evaluation Technology — Electronic Technology — Technical Analysis — Measurement Engineering — Structures, Materials, and Life Safety [4] — Building Environment [4] — Technical Evaluation and Application [4] — Fire Technology.

**THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY** conducts research and provides technical services designed to aid Government agencies in improving cost effectiveness in the conduct of their programs through the selection, acquisition, and effective utilization of automatic data processing equipment; and serves as the principal focus within the executive branch for the development of Federal standards for automatic data processing equipment, techniques, and computer languages. The Institute consists of the following divisions:

Computer Services — Systems and Software — Computer Systems Engineering — Information Technology.

**THE OFFICE FOR INFORMATION PROGRAMS** promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal Government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System; provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Relations.

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Part of the Center for Radiation Research.
[3] Located at Boulder, Colorado 80302.
[4] Part of the Center for Building Technology.

NATIONAL BUREAU OF STANDARDS
OCT 15 1974

# Publications of the National Bureau of Standards 1973 Catalog

## A Compilation of Abstracts and Key Word and Author Indexes

Betty L. Oberholtzer, Editor

Office of Technical Publications
National Bureau of Standards
Washington, D.C. 20234

U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, *Secretary*

NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

Issued July 1974

Library of Congress Catalog Number: 48-47112

National Bureau of Standards Special Publication 305 Supplement 5

To Accompany National Bureau of Standards Special Publication 305; and its Supplements 1, 2, 3, and 4

Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 5, 349 pages (July 1974)

CODEN: XNBSAV

Issued July 1974

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
(Order by SD Catalog No. C13.10:305 Suppl. 5). Price $4.15
Stock Number 0303-01240

# PREFACE

This annual NBS publications catalog provides complete citations for all National Bureau of Standards papers published in both NBS and non-NBS media during 1973. These papers document the results of NBS research, development, and service activities in furtherance of the Bureau's mission to strengthen and advance the Nation's science and technology, and to facilitate their effective application for public benefit. About one-half of the papers were issued in the Bureau's own publication series; the other one-half appeared in other (non-NBS) professional and technical journals and books.

As in past annual supplements, the citations for all NBS papers, whatever the publication medium, include the full title, author(s), place of publication, abstract, and key words. Permuted author and key word indexes facilitate use of the catalog and enhance its value as a reference. Also included is information on previous NBS catalogs, and an availability-status table on NBS papers published in previous years. A back-edge index permits ready location of the contests.

The 1973 catalog lists, for the first time the Tables of Contents for the year's issues of the Bureau's monthly newsmagazine, DIMENSIONS/NBS (until July 1973, the NBS Technical News Bulletin). Another new feature is a listnig of those reports submitted to sponsors of NBS work, designated NBS Interagency Reports (NBSIR).

Those NBS papers that are published by the Government Printing Office are sold by the Superintendent of Documents, and also in microfilm form by the National Technical Information Service (NTIS). These publications are listed herein by the respective NBS subject series in which they were published. NBS-authored papers which appeared in non-NBS publications are cited separately in numerical sequence.

This catalog, like past supplements to NBS Special Publication 305, was produced utilizing computer-assisted photocomposition techniques.

W. R. Tilley, *Chief*
*Office of Technical Publications*

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# 1. NBS PUBLICATION PROGRAM

## 1.1 INTRODUCTION

The National Bureau of Standards formal publication program provides a principal and effective means of communicating the results of the Bureau's research, development, and service activities to the scientific, technical, and academic community, as well as to the general public. Publications thus constitute a major end product of the Bureau's efforts, totalling about 1200 papers per year. These take the form of the Bureau's three periodicals, its ten nonperiodical publications, NBS interagency reports (NBSIR), and articles in the journals of professional organizations and technological associations.

This book, Publications of the National Bureau of Standards, lists those publications representing the results of the Bureau's in-house programs; these publications are as follows:

## 1.2. PERIODICALS

### 1.2.1. JOURNAL OF RESEARCH

The *Journal of Research* reports research and development in physics, mathematics, chemistry, and engineering. Comprehensive scientific papers give complete details of the work, including laboratory data, experimental procedures, and theoretical and mathematical analyses. The *Journal* also presents review articles by recognized authorities and compilations of information on subjects closely related to the Bureau's technical program. The *Journal of Research* is issued in two separate sections as follows:

*A. Physics and Chemistry*

This section presents papers of interest primarily to scientists working in these fields. It covers a broad range of physical and chemical research, with major emphasis on standards of physical measurements, fundamental constants and properties of matter. Issued six times a year.

Editor: C. W. Beckett
Associate Editor: D. D. Wagman

*B. Mathematical Sciences*

This section presents studies and compilations designed mainly for the mathematician and theoretical physicist. Topics in mathematical statistics, theory of experiment design, numerical analysis, theoretical physics and chemistry, logical design and programming of computers and computer systems are covered, together with short numerical tables. Issued quarterly.

Editor: M. Newman
Associate Editor: F. W. Olver

### 1.2.2. DIMENSIONS/NBS (formerly Technical News Bulletin)

This monthly magazine is published to inform scientists, engineers, businessmen, industry, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on the work at NBS.

DIMENSIONS/NBS highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, DIMENSIONS/NBS reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing.

The table of contents for each issue in 1973 are listed in Section 3.3, pages 32-34. Issued monthly.

Managing Editor: S. A. Washburn

### 1.2.3. JOURNAL OF PHYSICAL AND CHEMICAL REFERENCE DATA (JPCRD)

This journal is published quarterly by the American Chemical Society and the American Institute of Physics for the National Bureau of Standards. The objective of the Journal is to provide critically evaluated physical and chemical property data, fully documented as to the original sources and the criteria used for evaluation. Critical reviews of measurement techniques, whose aim is to assess the accuracy of available data in a given technical area, are also included. The principal source for the Journal is the National Standard Reference Data System (NSRDS). The Journal is not intended as a publication outlet for original experimental measurements such as are normally reported in the primary research literature, nor for review articles of a descriptive or primarily theoretical nature.

## 1.3. NONPERIODICALS

Ten categories of nonperiodical publications, described as follows, are listed in this catalog:

MONOGRAPHS—major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

HANDBOOKS—recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

SPECIAL PUBLICATIONS—include proceedings of high-level national and international conferences sponsored by NBS, precision measurement and calibration volumes, NBS annual reports, and other special publications appropriate to this grouping such as wall charts and bibliographies.

APPLIED MATHEMATICS SERIES—mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

NATIONAL STANDARD REFERENCE DATA SERIES—provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS. Program under authority of National Standard Data Act (Public Law 90-396). See also Section 1.2.3.

BUILDING SCIENCE SERIES—disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

TECHNICAL NOTES—studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analagous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

VOLUNTARY PRODUCT STANDARDS—developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The purpose of the standards is to establish nationally recognized requirements for products, and to provide all concerned interests with a basis for common understanding of the characteristics of the products. The National Bureau of Standards administers the Voluntary Product Standards program as a supplement to the activities of the private sector standardizing organizations.

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATIONS (FIPS PUBS)—publications in this series collectively constitute the Federal Information Processing Standards Register. The purpose of the Register is to serve as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations). FIPS PUBS will include approved Federal information processing standards information of general interest, and a complete index of relevant standards publications.

CONSUMER INFORMATION SERIES—practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

### 1.4. NBS INTERAGENCY REPORTS

A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service (Springfield, Va. 22151) in paper copy or microfiche form.

### 1.5. NBS BIBLIOGRAPHIC SUBSCRIPTION SERVICES

The Cryogenic Data Center and the Electromagnetics Division of the National Bureau of Standards, Boulder, Colorado have developed specialized bibliographic issuances designed to provide interested audiences with information on latest developments in certain specialized fields. These issuances, together with subscription information, are listed below:

*NBS Bibliographic Subscription Services*

**CRYOGENIC DATA CENTER CURRENT AWARENESS SERVICE** (Publications and Reports of Interest in Cryogenics). A literature survey issued weekly. Annual subscription: Domestic, $20.00; Foreign, $25.00.

**LIQUEFIED NATURAL GAS.** A literature survey issued quarterly. Annual subscription: $20.00.

**SUPERCONDUCTING DEVICES AND MATERIALS.** A literature survey issued quarterly. Annual subscription: $20.00.

Send subscription orders and remittances for the preceding bibliographic services to the U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia 22151.

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**Electromagnetic Metrology Current Awareness Service** (Abstracts of Selected Articles on Measurement Techniques and Standards of Electromagnetic Quantities from D-C to Milli-

meter-Wave Frequencies). Issued monthly. Annual subscription: $100.00 (Special rates for multi-subscriptions). Send subscription order and remittance made payable to the Dept. Comm./NBS to the Electromagnetic Metrology Information Center, Electromagnetics Division, National Bureau of Standards, Boulder, Colorado 80302.

### 1.6. PAPERS PUBLISHED BY OTHERS

Many significant contributions by NBS authors are published in other journals. Up-to-date listings of these articles are carried regularly in each section of the Journal of Research, along with selected abstracts. A complete listing is published annually in NBS SP305, along with abstracts, key words, and author/subject indexes.

## 2. PURCHASE PROCEDURES AND DOCUMENT AVAILABILITY

### 2.1. PURCHASE PROCEDURES

The publications of the Bureau are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at the prices listed in this publication. However, prices are subject to change without notice. You may also order through the U.S. Department of Commerce Field Office nearest you (see page for list of Field Offices of the U.S. Department of Commerce). Microfiche copies of all recent NBS publications, and paper copies and many non-periodicals, may be ordered through the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22151.

This section includes price lists of available publications, plus instruction on how to acquire reprints of articles by NBS authors, and how to get out-of-print material.

**How To Make Remittances.** Remittances for publications for which individual sales or subscription prices are shown should be mailed to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, by coupon, postal money order, express money order, or check. Postage stamps will not be accepted. Publications cannot be mailed before remittances are received. *Foreign remittances should be made either by international money order or draft on an American bank.*

The letter symbol, publication number, full title of the publication, SD catalog number, and SD stock number MUST be given when ordering. The Superintendent of Documents allows a discount of 25 percent on orders of 100 or more copies of one publication.

For the convenience of the general public, coupons in the denomination of five cents may be purchased from the Superintendent of Documents. These may be exchanged for Government publications sold by the Superintendent's office. Address order to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Persons who make frequent purchases from the Superintendent of Documents may find a deposit account convenient. Deposits of $25 or more are accepted against which orders may be placed without making individual remittances or first obtaining quotations. Order blanks are furnished for this purpose. After the order has been processed, the order itself is returned, showing the publications supplied, explanations regarding those not sent, the amount of charge, and the balance on deposit.

No charge is made for postage on documents sent to points in the United States and possessions or to Canada, Mexico, Newfoundland (including Labrador), and certain Central and South American countries. To other countries the regular rate of postage is charged and remittances must cover such postage. In computing foreign postage, add one-fourth of the price of the publication to cover the cost of shipping and handling charges.

Orders for publications purchased from the National Technical Information Service (NTIS) must be accompanied by postal money order, express money order, or check made out to the NTIS and covering total cost of the publications order. Information concerning NTIS coupons can be obtained directly from NTIS. All inquiries or orders should be addressed to: National Technical Information Service, Springfield, Virginia 22151.

SD and NTIS order forms are included at the end of this publication for your convenience in ordering.

### 2.2. ANNOUNCEMENTS OF NBS PUBLICATIONS

The National Bureau of Standards and the agencies mentioned below regularly issue the following official announcements dealing with NBS publications.

**DIMENSIONS/NBS.** Issued monthly by the National Bureau of Standards. In addition to publishing technical news of the Bureau, this periodical announces selected new publications in an NBS series. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription, $6.50; $8.25 foreign. Single copies, 65 cents each.

**NBS JOURNAL OF RESEARCH.** Both Sections A and B carry a listing of all NBS publications as issued. See 2.6 for subscription information.

*Monthly Catalog of United States Government Publications.* Issued monthly by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription, with consolidated annual index, $19.35; $24.20 foreign.

*Selected List of U.S. Government Publications.* Issued monthly by the Superintendent of Documents. Each list is arranged by subject, with annotations, prices, and order form. May be obtained free from the Superintendent of Documents, Attn: Selected List, P.O. Box 1821, Washington, D.C. 20013.

*Business Service Creck List.* Weekly announcement of publications of the Department of Commerce. Lists titles and prices of National Bureau of Standards Publications, as well as those of other offices of the Department of Commerce. Available from the Superintendent of Documents. Annual subscription, $7.20; $9.00 foreign.

## 2.3. CATALOGS OF NBS PUBLICATIONS

Previous catalogs, plus this publication, constitute a complete list of the titles of the Bureau's publications through December 31, 1973. The catalogs are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or may be consulted in a library which maintains sets of National Bureau of Standards publications.

Circular 460: Publications of the National Bureau of Standards 1901 to June 30, 1947. 375 pages, including subject and author indexes. Brief abstracts are included for the period January 1, 1941 to June 30, 1947 ..... $1.25

Supplement to Circular 460: Publications of the National Bureau of Standards, July 1, 1947 to June 30, 1957. 373 pages, including subject and author indexes ..... $1.50

Miscellaneous Publication 240: Publications of the National Bureau of Standards July 1, 1957 to June 30, 1960. First NBS Catalog to Include Titles of Papers Published in Outside Journals 1950 to 1959. 391 pages, including subject and author indexes ..... $3.50

Supplement to Miscellaneous Publication 240: Publications of the National Bureau of Standards published by NBS, July 1960 through June 1966; published by others, 1960 through 1965. 740 pages, including subject and author indexes $4.00

Special Publication 305: Publications of the National Bureau of Standards published by NBS. July 1966 through December 1967; published by others, 1966–1967. 223 pages, a citation of titles and abstracts, with key words and author indexes ..... $2.00

Supplement 1 to Special Publication 305: Publications of the National Bureau of Standards, 1968 through 1969. 497 pages, a citation of titles and abstracts, with key words and author indexes .. $4.50

Supplement 2 to Special Publication 305: Publications of the National Bureau of Standards, 1970. 378 pages, a citation of titles and abstracts, with key words and author indexes .. $3.25

Supplement 3 to Special Publication 305: Publications of the National Bureau of Standards, 1971. 342 pages, a citation of titles and abstracts, with key words and author indexes .... $3.00

Supplement 4 to Special Publication 305: Publitions of the National Bureau of Standards, 1972. 449 pages, a citation of titles and abstracts, with key words and author indexes ..... $3.75

Supplement 5 to Special Publication 305: Publications of the National Bureau of Standards, 1973. 349 pages, a citation of titles and abstracts, with key words and author indexes ..... $4.15

## 2.4. FUNCTIONS OF DEPOSITORY LIBRARIES IN THE UNITED STATES

The Superintendent of Documents, United States Government Printing Office, is authorized by law to furnish Government publications to designated depository libraries. The libraries listed in Appendix A are now receiving selected publication series of the National Bureau of Standards for general reference use. Whether a given library has a copy of a particular publication can be determined by inquiring at the library.

## 2.5. FUNCTIONS OF U.S. DEPARTMENT OF COMMERCE FIELD OFFICES

Department of Commerce Field Offices are maintained in the cities listed in Appendix B. Their purpose is to provide ready access, at the local level, to the services of the Department of Commerce as well as to its reports, publications, statistical statements, and surveys. Each Field Office serves as an official sales agent of the Superintendent of Documents, U.S. Government Printing Office, making available for purchase locally a wide range of Government publications. The reference library maintained by each Field Office contains many Government and private publications, periodicals, directories, reports, and other reference materials.

## 2.6. AVAILABILITY OF NBS PUBLICATIONS

### A. PERIODICAL SUBSCRIPTION RATE

| Periodical | Domestic [1] | Foreign [2] |
|---|---|---|
| Journal of Research of the National Bureau of Standards: | | |
| Section A. Physics and Chemistry, issued six times a year, paper covers | $17.00 | $21.25 |
| Bound volume (1 volume per year), blue buckram | ([3]) | ([3]) |
| Section B. Mathematical Sciences, issued quarterly, paper covers | 9.00 | 11.25 |
| Bound volume (1 volume per year), green buckram ([4]) | ([3]) | ([3]) |
| DIMENSIONS/NBS, 12 monthly issues | 6.50 | 8.25 |

NOTE.—Send order, with remittance, to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[1] United States and its possessions, Canada, Mexico, Newfoundland (including Larador), and certain Central and South American countries.

[2] Foreign price includes the cost of the publication and postage.

[3] Prices of the bound volumes vary. The Superintendent of Documents will furnish prices on request.

### B. PRICE LISTS FOR NONPERIODICALS

The following lists give the numbers and prices of all NBS publications issued from 1901 through 1973 which are still in print. Those items in **boldface** denote the 1973 publications cited in this supplement. The prices shown herein supersede prices quoted in previous catalogs of NBS publications. Prices are subject to change without notice. Publications may be ordered from the Superintendent of Documents, U.S. Government Printing Office or from the U.S. Department of Commerce Field Office nearest you. SD order forms are included at the end of this publication for your convenience in ordering. Some NBS publications may be purchased from the National Technical Information Service. (See Section 2.1.)

When an item refers to "see—", the original item has been superseded by the item referenced, and the price shown is the sales price for the superseding publication. If "OP" is listed instead of a price, that publication is out of print. In such cases, your nearest depository library may still have a copy of the out-of-print item. (See Section 2.4 and Appendix A.)

## CIRCULARS (Discontinued Series)

| No. | Price |
|---|---|
| 3 see C547, Sec. 1 in part | OP |
| 8 see Mono. 90 | OP |
| 9 see C602 | OP |
| 10 see C425 | OP |
| 12 see C440 | OP |
| 16 see C555 | OP |
| 17 see Mono. 47 (COM 71-00691) | * |
| 25 see SP260 | $1.30 |
| 29 see C60 | OP |
| 31 see H100 | OP |
| 32 see C405 | OP |
| 35 see M183 | OP |
| 40 see C381 | OP |
| 44 see C440 | OP |
| 47 see M286 | 2.25 |
| 49 see H8 | OP |
| 51 see C432 | OP |
| 52 see C387 | OP |
| 54 see H3 & H4 | OP |
| 57 see C410 | * |
| 61 see H44, 4th Ed | 5.40 |
| 62 see C424 | OP |
| 65 see C417 | OP |
| 75 see C397 | OP |
| 76 see C346 | OP |
| 82 see C361 | OP |
| 83 see C333 | OP |
| 95 see C426 | OP |
| 100 see C592 | OP |
| 101 see C447 | OP |
| 131 see C385 | OP |
| 138 see C385 | OP |
| 139 see C390 | OP |
| 154 see H71 | * |
| 239 see C363 | OP |
| 257 see C365 | OP |
| 280 see C406 | OP |
| 294 see C407 | OP |
| 300 see C418 | OP |
| 319 see C378 | OP |
| 322 see C360 | OP |
| 328 see Mono. 15 | OP |
| 330 see C362 | OP |
| 332 see Mono. 15 | OP |
| 339 see C363 | OP |
| 371 see C378 | OP |
| 375 see C457 | OP |
| 380 see C418 | OP |
| 383 see C424 | OP |
| 390 see H71 | * |
| 392 see C432 | OP |
| 396 see C418 | OP |
| 398 see SP260 | $1.30 |
| 399 see C406 | OP |
| 400 see C426 | OP |
| 402 | .25 |
| 410 | * |
| 413 see C426 | OP |
| 414 see H71 | * |
| 415 see Mono. 47 (COM 71-00691) | * |
| 428 see SP374 | 3.00 |
| 434 see C602 | OP |
| 435 see H71 | * |
| 438 | * |
| 454 (PB192338) | ** |
| 450 see C579 | * |
| 456 see Mono. 47 (COM 71-00691) | * |
| 460 | 1.25 |
| 462 see Mono. 80 in part | OP |
| 464 | * |
| 465 see H90 (PB 188654) | ** |
| 466 see H71 | * |
| 467 Vol. I see NSRDS 35 Vol. I | $9.25 |
| 467 Vol. II see NSRDS 35 Vol. II | 7.95 |
| 467 Vol. III see NSRDS 35 Vol. III | 8.30 |
| 474 see C576 | * |
| 477 see C555 | OP |
| 478 see Mono. 104 | .90 |
| 482 see C509 | OP |
| 485 see Mono. 106 | OP |
| 495 see Mono. 88 | .85 |
| 499 | * |
| 500 see TN270-3; 4; 5; and 6 | |
| 506 see C576 | * |
| 508 see C561 | OP |
| 510 (PB192339) | ** |
| 510 Suppl. 1 (PB192340) | ** |
| 510 Suppl. 2 (PB192341) | ** |
| 518 see Mono. 70 Vol I in part (PB168072) | ** |
| 533 see SP374 | 3.00 |
| 536 | .55 |
| 537 see NSRDS-NBS 10 | .95 |
| 539 Vol. 1 to 10 are now PB178902 to PB178911 | ** |
| 542 (PB188806) | ** |
| 552 see SP260 | 1.30 |

*See page 18 for additional information.

**Available from the National Technical Information Service; use "PB, AD, COM," or NBS publication identification if no specific NTIS number is assigned.

## CIRCULARS (Discontinued Series)

| No. | Price | No. | Price | No. | Price |
|---|---|---|---|---|---|
| 553 (COM 73-1112) | ** | 571 (PB175659) | ** | 589 (PB188296) | ** |
| 556 (PB172004) | ** | 572 see Mono. 15 | OP | 592 see Mono. 106 | OP |
| 559 see H71 | * | 576 | * | 593 | $.45 |
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Certain NBS publications are out of print because they have been replaced, or partially replaced, by material issued by other organizations. In this connection, NBS is able to offer the following information:

*Circular 410, National Standard Petroleum Oil Tables.* Information in this Circular has been incorporated in the ASTM-IP Petroleum Measurement Tables issued by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103. Available at $8.75 ($6.50 to ASTM members). Tables 5 and 7 of the ASTM-IP Tables may also be purchased from the ASTM in separate reprint form at $1.50 a copy for the two tables.

*Circular 438, Static Electricity.* The National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110, has issued a publication by the same title, available from them as NFPA Publication 77M, at $1.00.

*Circular 464, Gas Calorimeter Tables.* The American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103, has issued a publication on this subject. Listed as ASTM D900-55, it can be ordered at 75 cents per copy.

*Circular 499, Nuclear Data.* The publication of nuclear data is being continued in a new journal entitled *Nuclear Data,* published by Academic Press, 111 Fifth Avenue, New York, N.Y. 10003.

*Circular 564, Tables of Thermal Properties of Gases.* A reprinted edition is available from University Microfilms, Inc., Ann Arbor, Michigan 48106. Order as OP 12,192 for $29.90. Microfiche of this Circular is available from Cryogenic Data Center, National Bureau of Standards, Boulder, Colorado 80302 for $4.50.

*Circular 576, Automotive Antifreezes.* For information on this subject consult American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

*Circular 577 and Supplement, Energy Loss and Range of Electrons and Positrons.* These have been superseded by NASA Special Publication 3012, available from the National Technical Information Service, Springfield, Va. 22151, at

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*Miscellaneous Publication 179, American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures.* The American National Standards Institute, 1430 Broadway, New York, N.Y. 10018, has issued a publication on this subject. Available from them as A58.1-1969, at $2.75.

*Miscellaneous Publication 187, Directory of Commercial and College Laboratories.* A new Director of College and Commercial Testing Laboratories is published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103, at $3.50.

*Miscellaneous Publication 211, American Standard Building Code Requirements for Masonry.* The American National Standards Institute, 1430 Broadway, New York, N.Y. 10018, has issued a publication on this subject. Available from them as A41.1-1953-R1970, at $1.00.

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*Handbook 71, Specifications for Dry Cells and Batteries.* For more information on this Handbook, write to American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

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*Handbook 81 and its Supplements, Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines* (also H30 and H110-1). The American National Standards Institute, 1430 Broadway, New York, N.Y. 10018 has issued a publication on this subject. Available from them as ANS C2, at $5.50.

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*Handbook 102, ASTM Metric Practice Guide.* American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103, has issued a publication as Document E380-72, at $1.50.

*Handbook 110-1, National Electrical Safety Code.* Part 1. Rules for Installation and Maintenance of Electric Supply and Communication Lines (also H30 and H81 and its Supplements). The American National Standards Institute, 1430 Broadway, New York, N.Y. 10018 has issued a publication on this subject. Available from them as ANS C2, at $5.50.

# 3. TITLES AND ABSTRACTS OF NBS PUBLICATIONS, 1973[1]

## 3.1. PAPERS FROM THE JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, SECTION A. PHYSICS AND CHEMISTRY, VOLUME 77A, JANUARY-DECEMBER 1973

### January-February 1973

**Spectrum and energy levels of neutral thulium,** J. Sugar and W. F. Meggers, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 1, 1-43 (Jan.-Feb. 1973).

Key words: Energy levels; spectrum; thulium; wavelengths.

A new set of measurements of the spectrum of neutral thulium covering the range of 2513 Å to 11750 Å is given. The light source utilized for the observations was a microwave-excited thulium-iodide lamp. Second spectrum lines were recognized by comparing the output of this lamp with that of a 6A sliding spark. The results of Zeeman effect studies of these lines are included. Analysis of these new data led to the discovery of 348 new energy levels and provided revised values for the 142 already published. Measured Landé *g* factors are given for most of the levels.

**Simultaneous measurement of specific heat, electrical resistivity, and hemispherical total emittance of niobium-1 (wt.%) zirconium alloy in the range 1500 to 2700 K by a transient (subsecond) technique,** A. Cezairliyan, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 1, 45-48 (Jan.-Feb. 1973).

Key words: Electrical resistivity; emittance; high-speed measurements; high temperature; niobium-zirconium alloy; specific heat; thermodynamics.

Simultaneous measurements of specific heat, electrical resistivity, and hemispherical total emittance of niobium-1 (wt.%) zirconium alloy in the temperature range 1500 to 2700 K by a subsecond duration pulse heating technique are described. Estimated inaccuracy of measured properties are: 3 percent for specific heat and hemispherical total emittance, and 0.5 percent for electrical resistivity. Properties of the alloy are compared with the properties of pure niobium. It was found that specific heat and emittance of the alloy were approximately 0.5 percent and 1.5 percent, respectively, higher than those of pure niobium. Electrical resistivity of the alloy was 0.5 percent lower than that of pure niobium. Like niobium, the alloy showed a negative departure from linearity in the curve of electrical resistivity versus temperature.

**Theory of disclinations: II. Continuous and discrete disclinations in anisotropic elasticity,** R. deWit, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 1, 49-100 (Jan.-Feb. 1973).

Key words: Burgers vector; continuum mechanics; defect; dipole; disclination; dislocation; distortion; Green's tensor; incompatibility; loop; plasticity; strain; Volterra.

A general theory of stationary disclinations for a linearly elastic, infinitely extended, homogeneous body is developed. Dislocation theory is extended in three different ways to include disclinations, i.e., from continuous distributions, discrete lines, and continuous distributions of infinitesimal loops. This leads to three independent definitions of the disclinations, which can be uniquely related to each other. These interrelationships clarify Anthony and Mura's approaches to disclination theory, which at first appear to diverge from the present theory. Mura's "plastic distortion" and "plastic rotation" are identified as the dislocation and disclination loop densities. The elastic strain and bend-twist are derived as closed integrals in terms of the defect densities, and shown to be state quantities. The theory reduces to classical dislocation theory when the disclinations vanish. For every discrete disclination line, it is always possible to find a "dislocation model," which is a dislocation wall terminating on the line that gives exactly the same elastic strain and stress.

**Photochemistry of methane in the photoionization region,** R. E. Rebbert and P. Ausloos, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 1, 101-107 (Jan.-Feb. 1973).

Key words: Ion-molecule reaction; ion pair yield; methane; photochemistry; photoionization; quantum yields.

Methane was irradiated with microwave operated helium (21.2 eV) and neon (16.7 – 16.8 eV) resonance lamps which were separated from the reaction vessel by an aluminum window. The quantum yields of the stable end products have been determined at methane pressures ranging from 1 to 20 torr. Over this pressure range the abundances of the primary ions, determined through various diagnostic experiments, are within experimental error the same at 21.2 eV as at 16.7 – 16.8 eV $[(CH_4^+ \simeq CH_3^+ \simeq 0.5, CH_2^+ \leq 0.02)$, and are in good agreement with the primary mass spectra obtained in a photoionization mass spectrometer under collision free conditions ($P < 10^{-5}$ torr). The $C_2H_5^+$ which is formed by the reaction: $CH_3^+ + CH_4 \rightarrow C_2H_5^+ H_2$ loses a proton by an undetermined mechanism to give $C_2H_4$ as a product.

There is no evidence for the formation of neutral fragments such as $H_2$, C, CH or $CH_2$ at 16.7 – 16.8 eV. The fact that the ionization quantum is equal to unity in this energy range accounts for the absence of these intermediates. At 21.2 eV where ($\Phi_{ionization} = 0.95$) there is concrete evidence for the formation of carbon atoms ($\Phi(C) \geq 0.002$).

In an attempt to demonstrate the usefulness of enclosed neon and helium resonance light sources in the ion-molecule kinetic studies, the relative probabilities of transfer of $H^-$ over $D^-$ from various partially deuterium labeled hydrocarbons in $C_2H_5^+$ (or $C_2D_5^+$) has been determined.

The results presented in this article resolve the existing disagreements between previous helium resonance photolysis studies on $CH_4$.

**Radiolysis of methane. Formation of acetylene,** R. E. Rebbert and P. Ausloos, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 1, 109-114 (Jan.-Feb. 1973).

Key words: Acetylene formation; electron scavenger; ion

[1] The various NBS publications series are grouped under subheadings within this section. The several volumes of the Journal of Research are presented consecutively within their appropriate subheadings. If a particular publications series is sought, consult the table of contents or the edge index on the back cover.

pair yields; methane; pulse radiolysis; vacuum ultraviolet photolysis.

The $^{60}$Co-gamma radiolysis (at 200 to 2000 torr) and the pulse radiolysis (100 to 760 torr) of methane has been investigated with the specific purpose of elucidating the mode of formation of acetylene. The following two reactions account for the formation of acetylene in the pulse radiolysis:

$$C_2H_5^+ + e \rightarrow C_2H_2 + H_2 + H \qquad \text{I}$$

$$C(^1S \text{ or } ^1D) + CH_4 \rightarrow C_2H_2 + H_2. \qquad \text{II}$$

Addition of $SF_6$ as an electron scavenger eliminates reaction I as a source of acetylene, but increases the yield of ethylene through the occurrence of a reaction such as:

$$C_2H_5^+ + SF_6^- \rightarrow C_2H_4 + HF + SF_5.$$

In the low dose rate $^{60}$Co-gamma radiolysis of $CH_4 - NO$ mixtures, reaction II is the only mode for formation of acetylene. The $C(^1S$ or $^1D)$ atoms which undergo reaction II are formed in the gamma radiolysis and pulse radiolysis, as well as in the 10 and 11.6–11.8 eV photolyses, through the dissociation process:

$$CH_4^* \rightarrow C + 2H_2.$$

In the gamma radiolysis, the $C_2H_5^+$ ion apparently is intercepted by accumulated products before undergoing homogeneous neutralization process 1. In the 16.7–16.8 and 21.2 eV photolyses, evidence is presented that the ions do not undergo homogeneous neutralization.

**The enhancement of water vapor in carbon dioxide-free air at 30, 40, and 50 °C,** R. W. Hyland and A. Wexler, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 1, 115-131 (Jan.-Feb. 1973).

Key words: Concentration of saturated water vapor in air; enhancement factor; moist air; moisture content of saturated air; saturated air; solubility of water vapor in air; water vapor.

The enhancement of water vapor in compressed atmospheric air was measured at 30, 40, and 50 °C over respective pressure ranges of 10 to 35 bars, 15 to 60 bars, and 10 to 100 bars. The data for each isotherm were fitted by the method of least squares to an empirical smoothing equation of the form $\ln f = a + bP$ where $f$ is the enhancement factor, $P$ is the total (absolute) pressure and $a$ and $b$ are constants. A detailed error analysis, necessary for the eventual use of the data in humidity standards work, shows that the calculated (predicted) values of $f$ have an estimated limit of systematic bias of $\pm 0.07$ percent and a maximum observed standard deviation of a predicted value of $\pm 0.2$ percent.

**The second interaction (cross) virial coefficient for moist air,** R. W. Hyland and A. Wexler, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 1, 133-147 (Jan.-Feb. 1973).

Key words: Interaction virial coefficients; moist air; second virial coefficient; virial coefficients; water vapor.

The results of calculations of the second interaction (cross) virial coefficient $B_{aw}$ for water vapor and air, based on enhancement data obtained at NBS at 30, 40, and 50 °C, are presented. Comparisons are made with the results of calculations based on the enhancement data of Politzer and Strebel, Webster, and Goff et al. and with the results of the theoretical calculations of Mason and Monchick and of Chaddock. An empirical equation is given for interpolation and extrapolation.

The random (one standard deviation) uncertainty in the mean values of $B_{aw}$, arising from the scatter of previously obtained NBS values of the enhancement factor is estimated to range from 0.7 percent at 30 °C to 1.4 percent at 50 °C. The estimated systematic uncertainties range from 4 percent at 30 °C to 6 percent at 50 °C, respectively.

**Solubility and surface properties of finely divided hydroxyapatite,** Y. Avnimelech, E. C. Moreno, and W. E. Brown, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 1, 149-155 (Jan.-Feb. 1973).

Key words: Bone mineral; calcium phosphate; hydroxyapatite; solubility product; surface.

Synthetic hydroxyapatite (OHAp), $Ca_5(PO_4)_3OH$, was prepared by slow addition of phosphoric acid to a boiling $Ca(OH)_2$ suspension. The solid, precipitated at a pH of about 12, was stabilized by prolonged boiling. The Ca/P ratio of the product was $1.69 \pm 0.04$ and it had a specific surface area of 26 $m^2/g$.

Samples of OHAp were equilibrated with phosphoric acid solutions. Within the pH range studied, 5 to 7, the solubility product, $(Ca)^5(PO_4)^3(OH)$, was found to be $6.3 \pm 2.1 \times 10^{-59}$ at 25 °C.

Substantial deviations of the overall dissolution reaction from OHAp stoichiometry were observed and are attributed to nonstoichiometric reactions occurring at the surface. A linear dependence of excessive phosphorus on the surface with decrease in pH was found. Estimated on the extent of deviation from stoichiometry caused by the surface reaction are given.

**Pyrolysis of anionic and thermally prepared polystyrenes,** L. A. Wall, S. Straus, R. E. Florin, and L. J. Fetters, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 1, 157-170 (Jan.-Feb. 1973).

Key words: Anionic polystyrene; molecular weight distributions; molecular weights; thermal polystyrene; polymers; polystyrene degradation; pyrolysis; thermolysis.

The changes in molecular weights, their distributions, and initial rates have been measured, for a series of polystyrenes prepared by thermal and anionic procedures. The information obtained and previous results can be explained to a very large extent by a kinetic chain decomposition comprised of competing end and random initiation, depropagation, intra- and intermolecular transfer and termination by combination.

**Modulus of natural rubber cross-linked by dicumyl peroxide. II. Comparison with theory,** L. A. Wood, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 1, 171-177 (Jan.-Feb. 1973).

Key words: Cross-linking of rubber; dicumyl peroxide; elasticity theory of rubber; entropy component; gel point; modulus of rubber; rubber elasticity; statistical theory of rubber elasticity; thermodynamics of rubber elasticity.

Thermodynamics and molecular considerations are applied to an examination of the equation $G = S(fp + B)T + H(fp + B) + A = 5.925 \times 10^{-3}(fp - 0.45)T + 0.0684(fp - 0.45) + 2.70$, found experimentally in Part I. $G$ is the shear modulus in Mdyn $cm^{-2}$ at a temperature $T$ for natural rubber cross-linked by adding $p$ parts of dicumyl peroxide per hundred of rubber (phr) and heating until a fraction $f$ of the peroxide is decomposed. $G^*$, the energy component of the modulus, is $H(fp + B) + A$. The ratio $G^*/G$ decreases from 1.00 at the gel point ($fp = 0.45$ phr) to 0.5 near 2 phr and to 0.09 at 23.8 phr. The modulus $G$ is related to $\nu_e$, the number of moles of effective sub-chains per $cm^3$, by the equation $G - G^* = \nu_e RT$ where $R$ is the gas constant. If each molecule of decomposed dicumyl peroxide of molecular weight $M_d$ produces one cross-link in the rubber of specific volume $\bar{v}_r$, then

it is predicted that $S = 2R(100M_d\bar{v}_r)^{-1} = 5.5535 \times 10^{-3}$ Mdyn cm$^{-2}$ phr$^{-1}$ K$^{-1}$, as compared with the experimental value 5.925 $\times 10^{-3}$. Theory gives no prediction of the values of $A$, or of $H$. The gel point may be located experimentally as the point where the slope of the modulus-temperature relation is zero. The value of $G$ at the gel point is the energy component $G^*$. The experimental value of $fp$ at the gel point permits a calculation of the molecular weight of the rubber before cross-linking as 193,000. The results afford a very satisfactory confirmation of the essential validity of the statistical theory of rubber elasticity in its simplest form, if due regard is paid to $G^*$, the energy component of the modulus.

## March-April 1973

**An adiabatic solution calorimeter and measurements of a standard reaction for solution calorimetry,** E. J. Prosen and M. V. Kilday, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 2, 179-203 (Mar.-Apr. 1973).

Key words: Adiabatic solution calorimeter; enthalpy of reaction of $H_2SO_4$ in aqueous NaOH; $H_2SO_4$, enthalpy of reaction in NaOH(aq); heat of reaction of $H_2SO_4$ in aqueous NaOH; heat of solution of $H_2SO_4$ in aqueous NaOH; solution calorimetry; thermochemistry.

This paper discusses in detail the design, construction, and performance of the vacuum jacketed, adiabatic solution calorimeter which was used for the work in the certification of two NBS Standard Reference Materials for solution calorimetry. As a test for the calorimetric precision the following enthalpies of reaction were measured (referred to the mass or moles of $H_2SO_4 \cdot 8H_2O$):

$$H_2SO_4 \cdot 8H_2O + 2.36\,(NaOH \cdot 2620\,H_2O) = (Na_2SO_4 \cdot 0.36\,NaOH \cdot 6193\,H_2O)_{soln}$$

$$\Delta H_r(298.15\text{ K}) = -590.692 \pm 0.101\ J \cdot g^{-1}$$

$$= -34{,}194 \pm 5.9\ \text{cal} \cdot \text{mol}^{-1}$$

$$H_2SO_4 \cdot 8H_2O + 2.6\,(NaOH \cdot 714\,H_2O) = (Na_2SO_4 \cdot 0.6\,NaOH \cdot 1866\,H_2O)_{soln}$$

$$\Delta H_r(298.15\text{ K}) = -590.828 \pm 0.193\ J \cdot g^{-1}$$

$$= -34{,}203.4 \pm 11.1\ \text{cal} \cdot \text{mol}^{-1}$$

**The enthalpy of solution of low quartz ($\alpha$-quartz) in aqueous hydrofluoric acid,** M. V. Kilday and E. J. Prosen, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 2, 205-215 (Mar.-Apr. 1973).

Key words: Enthalpy of soln, $SiO_2$; heat of soln, $SiO_2$(c); quartz, soln in HF(aq); reference material, soln calorimetry; $SiO_2$(c), soln in HF(aq); thermochemistry.

An adiabatic solution calorimeter was used to measure the enthalpy of solution of the NBS Standard Reference Material No. 1654 ($\alpha$-quartz or low quartz) for use as a reference standard for HF solution calorimetry. The enthalpy of solution of this material at a concentration of 5 grams in 1000 cm$^3$ of 24.4 weight percent HF(aq) is

$$-\Delta H_{soln}(353.15\text{ K}) = 2362.2 \pm 1.1\ J \cdot g^{-1}.$$

This value also applies to the enthalpy of solution of pure low quartz within the uncertainty limits given. The enthalpy of solution of quartz (in J $\cdot$ $g^{-1}$) as a function of the temperature, $T$, of reaction in 24.4 weight percent HF in the range 298 to 358 K, is

$$-\Delta H_{soln}(T) = 2275.0 + 1.586\,(T - 298.15).$$

Thus, the average $\Delta Cp$ for the reaction over the range, 298 to 358 K, is $-1.586 \pm 0.025$ J $\cdot$ $g^{-1}$ $\cdot$ K$^{-1}$. As a function of the concentration of HF solution in the range, 18 to 30 weight percent.

$$-\Delta H_{soln}(353.15\text{ K}) = 2362.10 + 1.429\,(\text{wt\%HF} - 24.40) + 0.069\,(\text{wt\%HF} - 24.40)^2.$$

From measurements of the enthalpies of solution of several samples of quartz and fused silica, the enthalpy difference between low quartz and silica glass at 298.15 K was determined to be $162.2 \pm 4.9$ J $\cdot$ $g^{-1}$ ($2.330 \pm 0.070$ kcal $\cdot$ mol$^{-1}$).

**Enthalpies of solution of BeO(c) in HF(aq) and in HCl(aq),** M. V. Kilday, E. J. Prosen, and D. D. Wagman, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 2, 217-225 (Mar.-Apr. 1973).

Key words: BeO(c), enthalpy of soln in HF(aq); BeO(c), enthalpy of soln in HCl(aq); BeO(c), enthalpy of reaction in HF(aq); beryllium oxide; enthalpy of solution; heat of solution; thermochemistry.

An adiabatic solution calorimeter was used to measure the enthalpies of the following reactions:

$$BeO(c) + [96\,HF + 338\,H_2O]\,(l) \rightarrow [BeF_2 + 94\,HF + 339\,H_2O](l)$$

$$\Delta H \text{ at } 298.15\text{ K} = -101.30 \pm 0.20\ \text{kJ} \cdot \text{mol}^{-1}$$

$$BeO(c) + [48\,HCl + 333\,H_2O]\,(l) \rightarrow [BeCl_2 + 46\,HCl + 334\,H_2O](l)$$

$$\Delta H \text{ at } 352.58\text{ K} = -54.19 \pm 0.22\ \text{kJ} \cdot \text{mol}^{-1}$$

$$\Delta H \text{ at } 298.15\text{ K} = -53.0 \pm 2.0\ \text{kJ} \cdot \text{mol}^{-1}$$

$\Delta Cp$ is $12.5 \pm 2.8$ J $\cdot$ mol$^{-1}$ $\cdot$ K$^{-1}$ for the first reaction in the range 298 to 325 K.

**The enthalpies of formation of BeO(c) and $BeF_2$(c),** V. B. Parker, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 2, 227-235 (Mar.-Apr. 1973).

Key words: $BeF_2$(c); BeO(c); beryllium fluoride; beryllium oxide; enthalpies of formation; $\Delta H\,f^\circ_{298.15K}$ [$BeF_2$(c)]; $\Delta H\,f^\circ_{298.15K}$ [BeO(c)]; thermochemistry.

Two of the key compounds in the evaluation and synthesis of a consistent set of thermodynamic values for the Be compounds are BeO(c) and $BeF_2$(c). The available measurements on the enthalpies of formation of these two compounds are presented with a detailed outline of the approach used to select the "best" values. $\Delta H\,f^\circ_{298.15K}$ [BeO(c)] $= -145.7 \pm 0.6$ kcal $\cdot$ mol$^{-1}$ ($-609.6 \pm 2.5$ kJ $\cdot$ mol$^{-1}$) and $\Delta H\,f^\circ_{298.15K}$ [$BeF_2$(c, quartz)] $= -245.4 \pm 0.8$ kcal $\cdot$ mol$^{+1}$ ($-1026.8 \pm 3.3$ kJ $\cdot$ mol$^{-1}$).

**Vapor pressure and heat of sublimation of tungsten,** E. R. Plante and A. B. Sessoms, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 2, 237-242 (Mar.-Apr. 1973).

Key words: Heat of sublimation; Langmuir vaporization; rate of vaporization; tungsten; vapor pressure.

The vapor pressure of tungsten was measured by the Langmuir method in the temperature range 2600 to 3100 K using a vacuum microbalance. Four series of data gave concordant results and three of the four series gave second and third law heats of sublimation in excellent agreement. A vapor pressure equation representing the data is $\log P(\text{atm}) = -45385/T + 7.871$, based on our mean third law heat and tabulated entropies at 2800 K. The mean third law heat of sublimation at 298.15 K is $205.52 \pm 1.1$ kcal mol$^{-1}$ ($859.90 \pm 4.6$ kJ mol$^{-1}$) where the uncertainty is an overall estimated error. Rates of vaporization are about 1/2 those previously accepted for tungsten.

**Gas phase far ultraviolet photolysis and radiolysis of vinyl**

**chloride,** P. Ausloos, R. E. Rebbert, and M. H. J. Wijnen, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 2, 243-248 (Mar.-Apr. 1973).

Key words: Gas phase; photolysis; quantum yield; radiolysis; vinyl chloride; vinyl radical.

Quantum yields of the major products formed in the far ultraviolet photolysis of $CH_2CDCl$ ($C_2H_2$, $C_2HD$, $C_2H_3D$, $C_2H_2D_2$, and 1,3-$C_4H_4D_2$) have been determined at 147 nm (8.4 eV), 123.6 nm (10.0 eV), and 104.8-106.7 nm (11.6-11.8 eV). The quantum yield of the stable vinyl radicals which can be unambiguously ascribed to the primary process ($CH_2CDCl + h\nu \rightarrow CH_2CD + Cl$) is 0.3 and 0.05 at 147 and 123.6 nm, respectively. The sharp decrease in the yield of vinyl radicals with the increase in energy of the incident photon beam is in part attributed to the decomposition of internally excited vinyl radicals to give acetylene as a product. At 147 nm, the combined yield of acetylene plus vinyl radicals is $0.95 \pm 0.05$. At the shorter wavelengths, approximately one acetylene molecule is formed per electronically excited vinyl chloride molecule. It is concluded that the dissociative process: $C_2H_3Cl^* \rightarrow C_2H_2 + H + Cl$, occurring via a $C_2H_3$ or $C_2H_2Cl$ intermediate adequately accounts for the reactive neutral species formed at higher photon energies. Isotopic labeling experiments show that the hydrogen atoms are detached from both positions of the parent molecule. Ethylene which is a product over the entire wavelength range is in part formed via the reaction: $H^* + C_2H_3Cl \rightarrow C_2H_4 + Cl$, where H* represents a translationally excited hydrogen atom. The $C_2H_2DCl^+$ ions formed at 104.8-106.7 nm with a quantum yield of 0.47 do not contribute to the formation of acetylene or vinyl radicals. In the gas phase radiolysis of vinyl chloride, acetylene ($G \sim 1.5$) is mainly formed in the dissociation of neutral electronically excited vinyl chloride molecules. From this value, we may estimate that the ratio of neutral excited molecules formation to ionization in the radiolysis of vinyl chloride is 0.39. Vinyl ions, which are also produced ($G \sim 0.28$-0.35) react mainly by addition to vinyl chloride.

**Pulse radiolysis of methane,** R. E. Rebbert, S. G. Lias, and P. Ausloos, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 2, 249-257 (Mar.-Apr. 1973).

Key words: Electron scavengers; gas phase; ion-molecule reactions; methane; neutralization; pulse radiolysis.

The pulse radiolysis of methane has been studied in the absence and presence of electron scavengers such as $SF_6$ and $CD_3I$ and positive ion scavengers such as $i$-$C_4D_{10}$ in order to define the role of the intermediates H, C, CH, $CH_2$, $CH_3$,$CH_5^+$, and $C_2H_5^+$ in product formation. The dose rate was varied from 0.68 to $15.2 \times 10^{19}$ eV/g-s, the dose (number of pulses) was varied, and the duration of the pulse was changed from 3 ns to 100 ns. The variation of the yields of the ethylene and ethane products with dose is explained by the reaction of H-atoms with accumulated ethylene product. The fast reacting C, CH, and $^1CH_2$ species insert into methane to form acetylene, ethylene, and ethane products, but all of the reactions of these species cannot be completely specified since they may originate in upper electronic states, whose reactions with methane are unknown. Product formation by the slow reacting $^3CH_2$ and $CH_3$ radicals is also examined; for instance, evidence is presented for the occurrence of the reaction: $^3CH_2 + CH_3 \rightarrow C_2H_4 + H$. Results indicate that the ions $CH_5^+$ and $C_2H_5^+$ undergo neutralization mainly through the processes

$$CH_5^+ + e \rightarrow CH_4 + H \quad .$$

$$C_2H_5^+ + e \rightarrow (C_2H_4)^* + H \rightarrow C_2H_2 + H + H_2(2H).$$

When $i$-$C_4D_{10}$ is added, a fraction of the $CH_5^+$ and $C_2H_5^+$ react with the additive rather than undergo neutralization. A calculation demonstrates that the fraction of ions undergoing reaction with a given concentration of $i$-$C_4D_{10}$ can be correctly predicted by assuming that the rate constant for neutralization of $CH_5^+$ and $C_2H_2^+$ is the same as that determined recently for the $t$-butyl ion.

**Relation of vitron theory to 2-layer-liquid immiscibility in binary silicate and borate glass melts,** L. W. Tilton, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 2, 259-272 (Mar.-Apr. 1973).

Key words: Binary borates; binary silicates; boron glass; glass; homogenization of glass melts; immiscible glass melts; immiscibility gaps; silica glass; structure of glass; vitron theory.

Silica-rich and boron-rich binary glasses resemble clathrates in having host cavities in which modifier oxides may be inclosed without stress as inactive guests until the cavities are approximately filled. Additional modification results in stress both in the holes of the matrix and the cavities of vitrons. Then the structure begins to disintegrate and mixing takes place. The required mole-percent modification is expressed by an equation of the form

$$100_{r_h} = \frac{100(A-\alpha)\cdot q/5}{(L-\delta-\alpha) + (A-\alpha)\cdot q/5}$$

where $A$ and $\alpha$ are the diameters of vitron cavity and matrix hole, respectively, $L$ is the linear extent of a modifier, and $q$ the proportion of glass-maker that forms vitrons. Computations for 66 glasses have been made to constitute a unified system covering approximately the gamut of typical modifiers.

The identity of parameters $A$ and $\alpha$ for silicates and borates leads to the suggestion that the vitron structure in boric-oxide glass is the regular icosahedron of 20 triangular faces to accommodate a neutral molecule of $(B_4O_6)_5$. Regular octahedra of $(B_4O_6)_2$, if present in the matrix, would provide matrix holes of approximately $\alpha$ in diameter.

## May-June 1973

**The International Practical Temperature Scale of 1968 in the region 13.81 K to 90.188 K as maintained at the National Bureau of Standards,** G. T. Furukawa, J. L. Riddle, and W. R. Bigge, *J. Res. Nat. Bur. Stand. (U.S.),* **77A** (Phys. and Chem.), No. 3, 309-332 (May-June 1973).

Key words: International Practical Temperature Scale; NBS-IPTS-68; NBS-1955 provisional scale; platinum resistance thermometer.

The reproducibility of the International Practical Temperature Scale of 1968 (IPTS-68) in the region of 13.81 K to 90.188 K using standard platinum resistance thermometers is discussed. The effect of errors above 0 °C on the calibration between 13 and 90 K is analyzed. Calibrations resulting from least squares and "fixed point" treatment of the data are compared. The results show that in general the NBS-IPTS-68 temperature scale maintained at the National Bureau of Standards (NBS) by reference standard platinum resistance thermometers is transferred to thermometers calibrated at the NBS within a few tenths of a mK between about 20 and 90.188 K and within about ±1 mK between 13.81 and 20 K. Agreements within a few mK are shown between the observed values of temperatures, employing platinum resistance thermometers calibrated in terms of the NBS-IPTS-68 scale, and the values of temperatures of the fixed points in the region 13.81 to 90.188 K given in the text of the IPTS-68.

**Radiance temperature of niobium at its melting point,** A. Cezair-

liyan, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 333-339 (May-June 1973).

Key words: High-speed measurements; high temperature; melting; niobium; radiance temperature; surface roughness.

A subsecond duration pulse heating method is used to investigate variations in the radiance temperature (at 650 nm) of niobium near and at its melting point. Measurements were made on several specimens with different surface conditions. The results do not indicate any dependence of radiance temperature (at the melting point) on initial surface conditions. The average radiance temperature (at 650 nm) at the melting point for twelve different niobium specimens is 2425 K on the International Practical Temperature Scale of 1968, with an average absolute deviation of 0.6 K and a maximum deviation of 1.2 K.

**An experimental search for gaseous reactivity between $AlF_3$ and HF near 1200 K,** T. B. Douglas and R. F. Krause, Jr., *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 341-342 (May-June 1973).

Key words: Aluminum fluoride; aluminum hydrofluorides; equilibrium constant; hydrogen fluoride; stability limits; transpiration measurements.

Using an accurate transpiration method, $AlF_3$ was sublimed near 1200 K into argon containing 0, 0.02, and 0.76 atm of HF, but no reaction between $AlF_3$ and the HF was detected within the precision (about 1%). Two alternative structures of $HAlF_4$ are postulated. An upper bound for extent of reaction corresponds to $\Delta H°_{298} > -33$ kcal ($-138$ kJ) for $AlF_3$ (g) + HF (g) = $HAlF_4$ (g); this indicates a far lower stability of $HAlF_4$ (g) than that of $LiAlF_4$ (g) or $NaAlF_4$ (g) when formed similarly.

**A numerical solution of the integral equation describing a photometric integrating sphere,** R. L. Brown, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 343-351 (May-June 1973).

Key words: Integrating sphere; photometry.

A photometric integrating sphere containing a single disk-shaped baffle and a point source with an arbitrary angular intensity distribution is described by an integral equation. Numerical solutions of this equation are presented for several different source distributions. The errors involved in comparing the various sources are evaluated as a function of baffle size and position.

**Crystallization of random copolymers, I.** C. Sanchez and R. K. Eby, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 353-358 (May-June 1973).

Key words: Copolymers; crystallization; growth rate; lamella thickness; melting temperature.

A theory of crystallization is formulated for random copolymers which crystallize with the noncrystallizable co-units incorporated into the crystalline lattice as defects. The appropriate melting point equation and other associated thermodynamic properties are derived for this model as a function of crystal thickness and comonomer concentration. The formation of lamellar type morphology is assumed to be a kinetically determined phenomena and nucleation theory is utilized accordingly. The isothermal lamella thickness is predicted to increase in a definitive manner as the noncrystallizable comonomer concentration $X$ increases, while the associated isothermal growth rate is predicted to decrease. The variation of lamella thickness with $X$ when the copolymer is quenched or cooled at a uniform rate is also qualitatively predicted. Under these conditions lamella thickness decreases with increasing $X$, which is in accord with previous experimental observations on random copolymers of tetrafluorethylene and hexafluoropropylene as well as other random copolymers. Theory also suggests how the surface free energy parameters $\sigma_e$ and $\sigma$ can be determined from isothermal crystallization experiments for a series of random copolymers of varying composition.

**Theory of disclinations: III. Continuous and discrete disclinations in isotropic elasticity,** R. deWit, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 359-368 (May-June 1973).

Key words: Burgers vector; continuum mechanics; defect; disclination; dislocation; distortion; Green's tensor; incompatibility; plasticity; strain.

A general theory of stationary disclinations is developed for a linearly elastic, infinitely extended, homogeneous, isotropic body. It is shown to be a special case of the anisotropic theory. Integral expressions are derived for the total displacement, elastic strain and bend-twist, and stress. Both continuous distributions and discrete lines are treated.

**Compressive fatigue coaxing in composites,** C. A. Berg and M. Salama, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 3, 369-373 (May-June 1973).

Key words: Coaxing; composites; compressive fatigue; fatigue.

Compressive fatigue experiments on unidirectional fiber reinforced composites, of both fiberglass and graphite fiber, reveal that compressive fatigue damage takes place by crack extension directly transverse to the fibers. It is also found that specimens which are first subjected to a few hundred thousand cycles of compressive fatigue at low stress levels, and then subjected to compressive fatigue at high stress levels, will survive longer at high stress levels than specimens which are placed under high compressive fatigue stresses from the outset. The increase of fatigue life at high compressive stress levels can be quite large; increases of fatigue life by as much as a factor of five were observed. The phenomenon of prolonging fatigue life at high stress levels by first "running in" a specimen at low stress levels is called coaxing, and is directly opposite to the often reported cumulative damage phenomena observed in tensile fatigue of composites. A possible mechanism for coaxing in compressive fatigue of composites is offered, and practical applications of the effect are suggested.

## July-August 1973

**The thermodynamic kelvin temperature scale from 273.15 K to 415 K,** L. A. Guildner and R. E. Edsinger, *J. Res. Nat. Bur. Stand. (U.S)*, **77A** (Phys. and Chem.), No. 4, 383-389 (July-Aug. 1973).

Key words: Gas thermometry; International Practical Temperature Scale of 1968; sorption; steam point; temperature standards; Thermodynamic Kelvin Temperature Scale.

The investigation of the effects of sorption in a gas thermometer used to realize the Thermodynamic Kelvin Temperature Scale has been continued. By eliminating sorbable material more completely from the gas thermometer, we attained higher gas purity. So little contaminant remained that further cleanup produced no significant effect on the values of thermodynamic temperatures measured between 0 °C and 142 °C. The results are presented by giving the differences between the values on the thermodynamic scale and the International Practical Temperature Scale of 1968. The value of the steam point was determined to be 99.970 °C(therm) with an uncertainty of ± 3.5 mK at the 99 percent confidence level (based on 3 times the estimate of the standard deviation).

**An alumina standard reference material for resonance frequency and dynamic elastic moduli measurement. II. Characteristic values for use from 25 °C to 1000 °C,** R. W. Dickson and E. Schreiber, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 4, 391-394 (July-Aug. 1973).

Key words: Alumina; elastic modulus; resonance frequency; shear modulus; standard reference material; Young's modulus.

The temperature dependence of Young's modulus and the shear modulus of polycrystalline alumina is given over the range of 25 to 1000 °C. Results are expressed in terms of the dimensionless ratio: modulus value at temperature divided by modulus value at 25 °C. The results are intended for use with Standard Reference Material No. 718 which is intended for calibration of apparatus used to determine elastic moduli of solids by a resonance technique. The worst agreement is $9.5 \times 10^{-4}$ for the flexure and $19.1 \times 10^{-4}$ for the torsion, between any two individual measurements, and we recommend these as the minimum acceptable limits in using the standards.

**Heat capacities of polyethylene from 2 to 360 K. I. Standard samples of linear and branched polyethylene whole polymer,** S. S. Chang and A. B. Bestul, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 4, 395-405 (July-Aug. 1973).

Key words: Branched polyethylene; calorimetry; glass transition; heat capacity; linear polyethylene; polyethylene; thermal analysis; thermodynamic properties.

Heat capacities of two well characterized polyethylene samples have been measured from 2 to 360 K in a precision vacuum adiabatic calorimeter. The two samples are derived from the same stocks from which NBS standard reference materials (SRM) 1475 and 1476 for linear and branched polyethylene whole polymers, respectively, were established. Both samples have been studied in the conditions as received. The branched polyethylene sample has also been studied following various thermal treatments in the calorimeter. The effect of thermal history on the behavior of branched polyethylene has also been studied by differential scanning calorimetry.

**The quasi-harmonic approximation and a generalized Grüneisen equation of state,** F. I. Mopsik, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No.4, 406-409 (July-Aug. 1973).

Key words: Crystal equation of state; frequency distribution; Grüneisen constant; Grüneisen equation of state; quasi-harmonic approximation; thermal expansion.

The validity of the Grüneisen equation of state for a solid having a continuous distribution of frequencies is investigated. It is shown that one cannot generally replace $\partial S/\partial V$ with the heat capacity multiplied by appropriate Grüneisen constants. A model frequency distribution is used to show the difference that can arise.

**Valence resonance states of $N_2^-$,** M. Krauss and D. Neumann, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 4, 411-412 (July-Aug. 1973).

Key words: Electron scattering resonance; excited states $N_2$; excited states $N^-$; inelastic scatter; $N_2^-$; valence excited states.

Resonance valence excited states of $N_2^-$ are calculated and used to interpret resonant excitation of the A and B states of $N_2$ by electron impact.

**Internal electric fields near isolated defects in ionic crystals,** H. S. Bennett, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 4, 413-417 (July-Aug. 1973).

Key words: Electric fields; $F$ centers; Gaussian function; Holtsmark function; isolated defects.

Integral representations for three distributions of internal electric fields near isolated defects in ionic crystals are given. These three distributions are the Gaussian distribution for electric fields associated with phonons, and two Holtsmark type distributions for electric fields associated with charged impurities when the Jahn-Teller effect is small and when it is large. Numerical values for the distributions and for the averages of squared-dipole matrix elements over them are tabulated in the conclusion.

**Wavelengths and energy levels of the second spectrum of cerium (Ce II),** C. H. Corliss, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 4, 419-546 (July-Aug. 1973).

Key words: Cerium; Ce II; energy levels; spectrum; wavelengths.

The second spectrum of cerium (Ce II) has been compiled in the wavelength region between 2500 Å and 24 000 Å. Of the 11 000 lines in the list, about 7500 are now classified as transitions between 192 odd levels and 288 even levels. The odd levels arise from 5 configurations ($4f5d^2$, $4f5d6s$, $4f6s^2$, $4f^26p$, and $4f^3$) and the even levels from 7 configurations ($4f^26s$, $4f^25d$, $4f5d6p$, $4f6s6p$, $5d^3$, $5d^26s$, and $5d6s^2$). The known levels extend up to only 52 000 $cm^{-1}$ although the ionization potential is known to be 35 000 $cm^{-1}$ higher.

## September-October 1973

**Enthalpies of precipitation of silver halides; entropy of the aqueous silver ion,** D. D. Wagman and M. V. Kilday, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 569-579 (Sept.-Oct. 1973).

Key words: AgBr; AgCl; AgI; $AgNO_3$; enthalpy of dilution; enthalpy of precipitation; enthalpy of solution; entropy; heat of reaction; KBr; KCl; solution calorimetry; thermochemistry.

The enthalpies of precipitation of silver halides and the enthalpies of solution of $AgNO_3$, KCl, and KBr in $H_2O$ were measured in an adiabatic solution calorimeter.

From the enthalpy measurements of KCl(c) and KBr(c) in $AgNO_3$(aq), and of $AgNO_3$(c) in KCl(aq), in KBr(aq), and in KI(aq), we calculated (in kJ · $mol^{-1}$) − 65,724, − 84,826, and − 111,124 for $\Delta H°$pptn(298.15 K) for the averages of the chloride, bromide, and iodide reactions, respectively.

A reevaluation of the data for the enthalpy of solution of $AgNO_3$(c) has resulted in our selected best value,

$$\Delta H°(\infty)(298.15\ \text{K}) = 22.730 + 0.084\ \text{kJ} \cdot \text{mol}^{-1}$$

$$= 5.433 \pm 0.020\ \text{kcal} \cdot \text{mol}^{-1}$$

A table of enthalpies of dilution of $AgNO_3$(aq) is also given.

The average standard entropy for the aqueous silver ion at 298.15 K is found to be

$$S°[\text{Ag}^+(\text{aq})] = 73.42 \pm 0.20\ \text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$= 17.55 \pm 0.05\ \text{cal} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}.$$

**Enthalpies of reaction of tris(hydroxymethyl)aminomethane in HCl(aq) and in NaOH(aq),** E. J. Prosen and M. V. Kilday, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 581-597 (Sept.-Oct. 1973).

Key words: Enthalpy of reaction; heat of solution; solution

calorimetry; standard reference material; THAM; TRIS; tris(hydroxymethyl)aminomethane; thermochemistry.

The enthalpy of reaction of tris(hydroxymethyl)-aminomethane, NBS Standard Reference Material 724a, measured in an adiabatic solution calorimeter at 298.15 K in 0.1 *N* HCl solution is $-245.76 \pm 0.26$ J · g$^{-1}$, and in 0.0500 *N* NaOH solution is $141.80 \pm 0.19$ J · g$^{-1}$. The conditions applicable and the factors included in the overall uncertainties are discussed in detail. For the reaction in 0.1 *N* HCl in the range, 293 to 303 K, $\Delta Cp = 1.435 \pm 0.023$ J · g$^{-1}$ · K$^{-1}$, and in 0.0500 *N* NaOH in the range, 295 to 303 K, $\Delta Cp = 1.025 \pm 0.025$ J · g$^{-1}$ · K$^{-1}$.

Possible sources of error in measurements of the reactions are discussed. A summary of other enthalpy measurements of the reaction in 0.1 *N* HCl is given.

**The enthalpy of reaction of tris(hydroxymethyl)aminomethane with hydrochloric acid,** A. P. Brunetti, E. J. Prosen, and R. N. Goldberg, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 599-606 (Sept.-Oct. 1973).

Key words: Enthalpy of reaction; solution calorimetry; standard reference material; tris(hydroxymethyl)-aminomethane; thermochemistry.

The enthalpy of reaction of tris(hydroxymethyl)aminomethane with 0.1 *N* HCl has been measured using an isoperibol solution calorimeter, employing a modified quartz thermometer and an automatic digital data acquisition system. The enthalpy value obtained at 298.15 K is $245.93 \pm 0.26$ J · g$^{-1}$. Particular attention was given to possible sources of systematic error in the electrical calibrations.

**Theory of disclinations: IV. Straight disclinations,** R. deWit, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 607-658 (Sept.-Oct. 1973).

Key words: Burgers vector; continuum mechanics; defect; dipole; disclination; dislocation; distortion; Green's tensor; incompatibility; loop; plasticity; strain; Volterra.

The general theory of disclinations developed earlier is applied to the special case of a straight disclination line. First the geometrical fields are found, such as the defect loop densities which correspond to Mura's new concepts of "plastic distortion" and "plastic rotation," the basic plastic fields (strain and bend-twist), the defect densities (dislocation and disclination), the characteristic vectors (Burgers and Frank), and the incompatibility. Then the static fields are found for the isotropic case, such as the displacement, total distortion, basic elastic fields, and the stress. It is shown that the disclination axis is moved by adding a dislocation to the disclination line. All these special results for the straight disclination line are shown to satisfy the general equations of the theory. As corollaries the following topics are also treated:

1. The finite and infinitesimal straight disclination dipole, which can be biaxial or uniaxial. It resembles the straight dislocation line.

2. The dislocation models of the straight disclination line and of the finite disclination dipole. They are terminating dislocation walls (tilt and twist).

3. The compensated disclination line and the bent dislocation wall.

4. Finally we show analytically a special case of a dislocation ending on a disclination.

**Optical properties of *U* centers in alkali halides and alkaline earth fluorides,** H. S. Bennett, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 659-665 (Sept.-Oct. 1973).

Key words: $BaF_2$; $CaF_2$; ionic polarization; KCl; Mollwo-Ivey relations; NaCl; point-ion potential; $SrF_2$; *U* centers.

The two-electron orbitals for the *U* center have been computed numerically from the Hartree-Fock-Slater (HFS) equations in the point-ion lattice potential. The lattice relaxation of the nearest-neighbor ions is included in the model. The five lowest-lying *U*-center states for NaCl, KCl, $CdF_2$, $CaF_2$, $SrF_2$, and $BaF_2$ are given. The low-lying singlet states have the following order for increasing values of the energy; $^1S(1s,1s)$, $^1P(1s,2p)$, and $^1S(1s,2p)$. The energy levels for the triplet states $^3S(1s,2s)$, and $^3P(1s,2p)$ lie between the energy levels for the $^1S(1s,1s)$ and $^1P(1s,2p)$ states. The ordering of the triplet states depends upon the host crystal and the lattice relaxation. The predictions based upon the numerical HFS wave functions are compared with the predictions based upon past variational wave functions and with experiment.

**Air flow rate as a test for gage block wringing,** L. A. Guildner, R. L. Anderson, and R. E. Edsinger, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 667-670 (Sept.-Oct. 1973).

Key words: End length standards; gage blocks; joining; wringing; wring test.

Gage blocks can be joined by "wringing" to produce a vacuum-tight joint. Hoke gage blocks have square gaging surfaces with a central hole connecting them. The quality of the joints between blocks can be tested by measuring the vacuum leak rates through the joints into the central hole. When two Hoke blocks are in contact at one edge but tilted at an angle $\phi$, the vacuum leak rate into a chamber of 22 cm$^3$ produces a rate of pressure increase which can be represented by the following polynomial:

$$dp/dt = 0.42\,\phi^2 + 0.022\,\phi^3\ \mu\text{m Hg/min},$$

where $\phi$ is in $\mu$rad. Hoke blocks in suitable condition to be joined by wringing can also be joined by alining them and evacuating the joint through the center hole.

**Low frost-point humidity generator,** L. Greenspan, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 5, 671-677 (Sept.-Oct. 1973).

Key words: Calibration; frost-point; generator; humidity; water vapor.

A low frost-point humidity generator has been developed at NBS to provide a capability for calibration, testing and research at very low levels of water vapor content in such gases as atmospheric air, carbon dioxide and nitrogen. The generator produces frost points from $-30$ to $-100$ °C at ambient pressures from 500 to 200,000 pascals (0.005 to 2 atm.). This is equivalent to mixing ratios of $4 \times 10^{-6}$ to 51 grams of water vapor per kilogram of dry air and to vapor pressures of $1.4 \times 10^{-3}$ to 38 pascals. The generated test gas can be fed to a test chamber with independent temperature control between $+25$ and $-100$ °C. The uncertainty of the frost point in the test chamber is estimated not to exceed 0.05 deg C. Intercomparisons with a frost-point hygrometer as well as two gravimetric checks gave results which in all cases agreed to within 0.2 deg C in frost-point temperature.

## November-December 1973

**Absolute isotopic abundance ratio and atomic weight of a reference sample of rhenium,** J. W. Gramlich, T. J. Murphy, E. L. Garner, and W. R. Shields, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 691-698 (Nov.-Dec. 1973).

Key words: Absolute ratio; atomic weight; isotopic abundance; rhenium.

An absolute value has been obtained for the isotopic abundance ratio of a reference sample of rhenium, using surface emission mass spectrometry. Samples of known isotopic composition, prepared from nearly isotopically pure separated rhenium isotopes, were used to calibrate the mass spectrometers. The resulting absolute $^{185}Re/^{187}Re$ ratio is $0.59738 \pm 0.00039$, which yields atom percents of $^{185}Re = 37.398 \pm 0.016$ and $^{187}Re = 62.602 \pm 0.016$. The atomic weight calculated from this isotopic composition is $186.20679 \pm 0.00031$. The indicated uncertainties are overall limits of error based on 95 percent confidence limits for the mean and allowances for the effects of known sources of possible systematic error.

**Reflection correction for high-accuracy transmittance measurements on filter glasses,** K. D. Mielenz and R. Mavrodineanu, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 699-703 (Nov.-Dec. 1973).

Key words: Correction for reflections; reflections, multiple; spectrophotometry, high accuracy; systematic bias in spectrophotometry; transmittance, correction.

Multiple reflections in the sample compartment of a spectrophotometer constitute a source of systematic bias in transmittance measurements on filter glasses. This bias may be removed by applying a numerical correction obtained from measurements on tilted samples in polarized light. For a high-accuracy spectrophotometer, this correction was found to be of the order of several $10^{-4}$ transmittance units, independent of polarization, but slightly wavelength-dependent.

**Temperature-pressure phase relationships in niobium pentoxide,** J. L. Waring, R. S. Roth, and H. S. Parker, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 705-711 (Nov.-Dec. 1973).

Key words: Niobium pentoxide; phase relationships; pressure; temperature.

A pressure-temperature ($P$-$T$) section of the phase equilibrium diagram for $Nb_2O_5$ has been determined. Four single phase regions, H-$Nb_2O_5$, B-$Nb_2O_5$, and two L-$Nb_2O_5$ areas, were characterized by x-ray powder diffraction data. The superstructure of L-$Nb_2O_5$ was indexed on the basis of similarities to the known superstructures of L-$Ta_2O_5$ and confirmed with single crystal electron diffraction data. The correct unit cell is orthorhombic with $a = 6.168$, $b = 29.312$, $c = 3.938$ Å, with the $b$ axis 8 times the subcell ($8 \times 3.664$ Å).

**Nuclear magnetic resonance of $^{113}Cd$ and $^{199}Hg$ in Cd-Mg and Cd-Hg solid solutions,** V. V. Zhukov, I. D. Weisman, and L. H. Bennett, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 713-723 (Nov.-Dec. 1973).

Key words: Anisotropic; Cd; Cd-Hg; internal Mg oxidation; isotropic; Knight shift.

The current theoretical and experimental situation with respect to Knight shifts and bulk susceptibility of Cd in pure Cd and in Cd-Mg and Cd-Hg alloys is reviewed. New experimental isotropic and anisotropic Knight shift data on $^{113}Cd$ in Cd-Mg and Cd-Hg alloys and on $^{199}Hg$ in Cd-Hg alloys are presented. The behavior of the $^{199}Hg$ sites is found to be remarkably similar to that of the $^{113}Cd$ site in the Cd-Hg alloys. However the ratio of isotropic Knight shift of $^{199}Hg$ to $^{113}Cd$ is somewhat greater than the ratio of $^{199}Hg$ to $^{113}Cd$ atomic hyperfine fields suggesting that there is more local electronic "*s*" character at the Fermi surface in the alloy than in the pure metals. This is consistent with the theoretical picture of Cd in which phonon scattering induced by increasing temperature or alloying smears and weakens the lattice potential which in turn leads to a more "*s*" like Fermi surface.

Further, the $^{113}Cd$ Knight shift is found to be a useful tool for monitoring the phase segregation that occurs in Cd-Mg due to internal oxidation and for determining the concentrations of solutes such as Hg and Mg in Cd-Hg and Cd-Mg alloys.

**The pair correlation function in liquid $^4He$,** R. D. Mountain and H. J. Raveché, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 725-731 (Nov.–Dec. 1973).

Key words: Ground state wave function; liquid $^4He$; neutron diffraction data; pair correlation function; short range behavior; structure factor; superfluid transition.

The pair correlation function obtained from the neutron diffraction data of Mozer, De Graaf, and Le Neindre, is given for liquid $^4He$ at several thermodynamic states above and below the superfluid transition. A method for smoothly and accurately extrapolating the pair function into the limit of zero internuclear separation is considered. The pair function is computed from an approximation integral equation for the ground state wave function and compared to the experimental results.

**Molecular basis of flame inhibition,** J. W. Hastie, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 733-754 (Nov.-Dec. 1973).

Key words: Fire retardants; flame inhibition; flames.

The role played by inorganic chemical additives in fire retardancy and flame inhibition is considered. Particular attention is given to the molecular level aspects of commercially important systems containing compounds of antimony, halogens, and phosphorus. The flame inhibiting function of metal containing additives is also discussed.

**The effect of temperature and pressure on the refractive index of some oxide glasses,** R. M. Waxler and G. W. Cleek, *J. Res. Nat. Bur. Stand. (U.S.)*, **77A** (Phys. and Chem.), No. 6, 755-763 (Nov.-Dec. 1973).

Key words: Interferometry; light scattering; oxide glasses; polarizability; pressure; refractive index; temperature coefficient of refractive index; thermal expansion.

The change in refractive index with temperature has been determined for some oxide glasses from about – 200 to 700 °C. The change in refractive index with applied hydrostatic pressure has been determined at room temperature from a pressure of $10^5$ to $10^8$ Pa. All measurements were made using the yellow spectral line of helium. A calcium aluminate glass, an aluminum magnesium phosphate glass, a binary barium borate glass and a multicomponent germanate glass were studied, as were four commercial specimens of fused silica. From the data at room temperature, it has been possible to calculate the change in electronic polarizability with temperature at constant volume. This parameter has been found to be very high for the glasses as compared to crystals, and this agrees with the results of earlier research on silica-based optical glasses. Furthermore, over the entire temperature range, the change of refractive index with temperature is shown to be due predominantly to the temperature dependence at constant volume of the electronic polarizability. The relevance of the data to the molecular scattering of light in glasses is discussed.

# 3.2. PAPERS FROM THE JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, SECTION B. MATHEMATICAL SCIENCES, VOLUME 77B, JANUARY-DECEMBER 1973

## January-June 1973

**Some Hamiltonian results in powers of graphs,** A. M. Hobbs, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 1-10 (Jan.-June 1973).

Key words: Combinatorics; connectivity; Euler graphs; 2-factors; graph theory; Hamiltonian circuits; Hamiltonian connected; powers of graphs.

In this paper we show that the connectivity of the $k$th power of a graph of connectivity $m$ is at least $km$ if the $k$th power of the graph is not a complete graph. Also, we prove that removing as many as $k-2$ vertices from the $k$th power of a graph ($k \geq 3$) leaves a Hamiltonian graph, and that removing as many as $k-3$ vertices from the $k$th power of a graph ($k \geq 3$) leaves a Hamiltonian connected graph. Further, if every vertex of a graph has degree two or more, then the square of the graph contains a 2-factor. Finally, we show that the squares of certain Euler graphs are Hamiltonian.

**On a functional equation,** A. O. L. Atkin, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 11-13 (Jan.-June 1973).

Key words: Analysis; continuous; equation; function; real.

Subject to suitable conditions of continuity and normalization, it is shown that the equation $f(x,y)+f(x+y,z)=f(y,z)+f(x,y+z)$ implies $f(x,y)=g(x)+g(y)-\epsilon(x+y)$. The result has application in physics to the motion of an electron in a crystal lattice.

**Matroid designs,** P. Young and J. Edmonds, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 15-44 (Jan.-June 1973).

Key words: Balanced incomplete block designs; matroid designs; matroids.

Matroids are investigated in which equicardinality conditions are imposed on the flats. Such matroids are shown to be closely related to certain types of BIBD's. Existence and uniqueness theorems for these structures are derived, together with a boundedness criterion on their rank. Several classes are exhibited, including finite projective and affine geometries, certain $t$-designs (Steiner systems) and so-called trivioids. By viewing certain $t$-designs as matroids, new ways of constructing BIBD's are derived. Three new series of 3-designs and two new 4-designs are obtained by these methods. A matroid analysis of the 5-(24,8,1) design of Witt is presented, and examples are obtained from it of matroids having equicardinal hyperplanes but not equicardinal flats in lower ranks. Several general conjectures and existence problems for these types of matroids are suggested.

**Extrapolation techniques related to transcendence proofs,** K. B. Stolarsky, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 45-51 (Jan.-June 1973).

Key words: Baker's extrapolation method; extrapolation; Hermite interpolation formula; transcendental numbers; transcendence proofs.

An extrapolation method used by A. Baker to study linear forms in the logarithms of algebraic numbers is further refined, and used to study a general extrapolation problem involving a function holomorphic in a large disk.

**A catalog of minimal blocks,** A. M. Hobbs, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 53-60 (Jan.-June 1973).

Key words: Blocks; combinatorics; examples of graphs; graph theory; minimal blocks; planar graphs; thickness of graphs; two-connected graphs.

In this paper we provide a catalog of the minimal blocks with 10 and fewer vertices, together with a discussion of the methods and theorems used to produce the catalog. In addition, we prove a theorem which is a strengthening of a similar theorem of Fleischner [2] on the structure of minimal blocks.

**On the eigenvalues of A+B and AB,** H. Wielandt, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 1 and 2, 61-63 (Jan.-June 1973).

Key words: Angular field of values; eigenvalues; field of values; hermitian; inertia; positive semidefinite.

Using the usual field of values and the angular field of values inclusion sets are found for the eigenvalues of sums and products of $n \times n$ complex matrices. For instance if the field of values of $B$ does not contain 0 it is found that the quotient of the field of values of $A$ by that of $B$ contains the eigenvalues of $AB^{-1}$. Applications are made to the polar form ($AB$ where $A$ is unitary and $B$ positive semidefinite) and to products $AB$ with $A$ hermitian and $B+B^*$ positive definite.

## July-December 1973

**An application of Schur's lemma on irreducible sets of matrices in continuum mechanics,** J. T. Fong, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 73-79 (July-Dec. 1973).

Key words: Continuum mechanics; elasticity; integration; matrix calculus; matrix identity; matrix theory; reducibility; Schur's lemma; strain energy.

In a recent study of the thermodynamic restrictions of a theory of compressible, viscoelastic fluids, Fong and Simmons (ZAMP **23**, No. 5 (1972)) encountered a problem of integrating the following matrix identity:

$$\underline{\underline{M}}[\underline{\underline{H}}\hat{U}_{,\underline{\underline{C}}}(\underline{\underline{H}}^T\underline{\underline{M}}\underline{\underline{H}})\underline{\underline{H}}^T - \hat{U}_{,\underline{\underline{C}}}(\underline{\underline{M}})] - \underline{\underline{H}}\hat{U}_{,\underline{\underline{C}}}(\underline{\underline{H}}^T\underline{\underline{H}})\underline{\underline{H}}^T \equiv \underline{\underline{O}},$$

where $\hat{U}_{,C}$ denotes the gradient of the scalar-valued function $U = \hat{U}(\boldsymbol{C})$ with respect to its matrix argument $\boldsymbol{C}$ which is symmetric and positive-definite. The identity is valid for every symmetric positive-definite $\boldsymbol{M}$ and every unimodular $\boldsymbol{H}$. The symbol $\boldsymbol{H}^T$ denotes the transpose of the matrix $\boldsymbol{H}$. The solution of the problem is presented here in detail as an example of applying, probably for the first time, Schur's lemma on irreducible sets of matrices in theoretical continuum mechanics.

**Remarks on a problem of Rademacher in the theory of modular forms,** M. I. Knopp, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 81-83 (July-Dec. 1973).

Key words: Dedekind function; modular form; partition function; Poincaré series.

Rademacher quite some time ago posed the question of deriving the classical functional equation of $1/\eta(z)$ ($\eta(z)$ is the Dedekind modular form) directly from the exact expression he had found for the partition function, $p(n)$, which arises as the Fourier coefficient of $1/\eta(z)$. Although he had been able to solve a similar problem for the absolute invariant $J(z)$, Rademacher was unable to solve the problem for $1/\eta(z)$. We here relate this question to some more recent results of Douglas Niebur, which reduce the problem to one of identically zero Poincaré series of degree $-5/2$.

**The characterizations of $(A_q(U))$,** M. E. Sheingorn, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 85-92 (July-Dec. 1973).

Key words: Automorphic functions; Hardy spaces.

For $q > 1$ Bers defines a Banach space $A_q(U) = \left\{ f \epsilon H(U) \mid \int_U |f(u)|(1-|u|^2)^{q-2} dxdy < \infty \right\}$ and shows that any bounded linear functional $\Lambda$ on $A_q(U)$ may be represented as $\Lambda(f) = \int_U f(u)\bar{G}(u)(1-|u|^2)^{2q-2} dxdy$ where $G \epsilon B_q(U) = \{h \epsilon H(U) \mid \sup_{u \epsilon U} |h(u)|(1-|u|^2)^q < \infty\}$ and is unique. This work is done in [1]. Duren, Romberg, and Shields, pursuant to their work on $H^p$ for $p < 1$, define a Banach space $B^p(p<1) = \left\{ f \epsilon H(U) \mid \int_0^{2\pi} \int_0^1 |f(re^{i\theta})|(1-r)^{1/p-2} dr d\theta < \infty \right\}$. They show that a bounded linear functional $\Lambda$ on $B^p$ may be uniquely represented as $\Lambda(f) = \lim_{r \to 1} \int_0^{2\pi} f_r(e^{i\theta}) \bar{g}(e^{i\theta}) d\theta$ where

(i) $f_r(e^{i\theta}) = f_r(re^{i\theta})$

(ii) $g \epsilon A = \{h \epsilon H(U) \mid g$ is continuous on $\bar{U}\}$ and $g^{(n-1)}$, and $n-1$ st derivative of $g$, is in $\Lambda_\alpha = \{h \epsilon H(U) \mid h'(re^{i\theta}) = 0((1-r)^{\alpha-1})\}$. (Here $\alpha = 1/p - n$ where $n < 1/p < n+1$, so $\alpha \neq 0$. If $1/p = n+1$, the conditions on $g$ are: $g \epsilon A$, $g^{(n-1)} \epsilon \Lambda_* = \{h \epsilon H(U) \mid h''(re^{i\theta}) = 0((1-r)^{-1})\}$.) This work appears in [2].

In this paper, after showing that $B^p \cong A_q(U)$ with $1/p = q$, we derive the relationship between $G$ and $g$, namely:

$$G(z) = \sum_{k=0}^{2n+1} A_k \cdot g^{(2k+1)}(z) \cdot z^{2k+1},$$

($|z| < 1$) where $A_i$ are constants, $A_{2n+1} \neq 0$. (in this case $q = 1/p$ is an integer. The Theorem is slightly different if $q$ is not an integer.)

**Character induced subgroups,** R. Merris and W. Watkins, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 93-99 (July-Dec. 1973).

Key words: Character of central type; central idempotent; Frobenius Reciprocity; group algebra; orthogonality relations; tensor product.

Given a finite group $G$ with an irreducible character $\chi$, define $G_\chi = \{ g \epsilon G: |\chi(g)| = \chi(1) \}$. Then $\chi(1)^2 \leq [G:G_\chi]$. We investigate the case of equality. There are applications to symmetry classes of tensors and generalized matrix functions.

**Performance testing of a FORTRAN library of mathematical function routines—A case study in the application of testing techniques,** D. W. Lozier, L. C. Maximon, and W. L. Sadowski, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 101-110 (July-Dec. 1973).

Key words: Automated testing; bit comparison; FORTRAN library; function validation; mathematical functions; performance tests.

This paper describes an application of testing methodology and techniques developed by the authors to aid in improving the quality of mathematical software. These techniques differ radically in several aspects from techniques previously used, the most important difference being that the testing is not based exclusively on random arguments. Instead, throughout the range of each function use is made of special arguments that are designed to detect programming errors and to test the performance of an algorithm in different regions. The function values are tested against reference values which are stored on reference tapes generated by a highly authenticated system of subroutines.

Since the effectiveness of such a testing system in discovering errors and performance limitations can be fully ascertained only through actual use, we report the results of employing our system to test an existing FORTRAN library of mathematical function routines. Specific aspects of the numerical accuracy of the library used in this test case are discussed in order to illustrate the effectiveness of a well-designed testing system as an analytic tool for the evaluation of mathematical software.

Since documentation provides information necessary to perform testing and contains specifications that reflect the results of testing, our study includes comments on the documentation.

No information on timing or storage requirements is presented in this case study.

**Bessel functions $I$ and $J$ of complex argument and integer order,** D. J. Sookne, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 111-114 (July-Dec. 1973).

Key words: Bessel functions; backward recursion; error bound; Miller algorithm; difference equation.

A computer program is described for calculating Bessel functions $J_n(z)$ and $I_n(z)$, for $z$ complex, and $n$ a nonnegative integer. The method used is that of backward recursion, with strict control of error, and optimum determination of the point at which to begin the recursion.

**Certification of an algorithm for Bessel functions of real argument,** D. J. Sookne, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 115-124 (July-Dec. 1973).

Key words: Bessel functions; bit comparison; error bounds.

The accuracy of routine BESLRI is certified.

**Bessel functions of real argument and integer order,** D. J. Sookne, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 125-132 (July-Dec. 1973).

Key words: Backward recursion; Bessel functions; difference equation; error bounds; Miller algorithms.

A computer program is described for calculating Bessel functions $J_n(x)$ and $I_n(x)$, for $x$ real, and $n$ a nonnegative integer. The method used is that of backward recursion, with strict control of error.

**Certification of an algorithm for Bessel functions of complex argument,** D. J. Sookne, *J. Res. Nat. Bur. Stand. (U.S.)*, **77B** (Math. Sci.), Nos. 3 and 4, 133-136 (July-Dec. 1973).

Key words: Backward recursion; Bessel function; bit comparison; error bounds; relative error.

Computer tests of algorithm BESLCI are described, and the results of the test are given.

**Triangles generated by powers of triplets on the unit circle,** C. R. Johnson and M. Newman, *J. Res. Nat. Bur. Stand. (U.S.),* **77B** (Math. Sci.), Nos. 3 and 4, 137-141 (July-Dec. 1973).

Key words: Convex hull; unit circle; Weyl's Theorem.

Let $\alpha, \beta, \gamma$ be three distinct complex numbers of modulus 1. It is shown that there is essentially one exception to the following statement: For some positive integer $m$, 0 is in the closed convex hull of $\alpha^m, \beta^m, \gamma^m$. The exception occurs for the normalized triple

$$1, e^{2\pi i/7}, e^{2k\pi i/7},$$

where $k=3$ or 5. This question was motivated by the problem of determining when a positive integer $m$ and a nonzero $n \times 1$ vector $\chi$ exist such that

$$\chi \approx A^m \chi = 0,$$

where $A$ is a given matrix of $M_n(C)$.

**Tables and graphs of the stable probability density functions,** D. R. Holt, *J. Res. Nat. Bur. Stand. (U.S.),* **77B** (Math. Sci.), Nos. 3 and 4, 143-198 (July-Dec. 1973).

Key words: Accuracy; approximations; asymptotic expansion; Cauchy distribution; characteristic function; closed forms; contour; convergence; curves; distribution function; error; Fourier transform; infinite series; interpolation; limit distribution; normal distribution; polynomials; probability density function; quadrature; stable distribution; sums of independent random variables; tables; truncation.

Four-decimal-place tables are presented of the probability density function $p(\chi; \alpha, \beta)$ of the stable distribution for $\alpha = 0.25(.25)2.00$, $\beta = -1.00(.25)1.00$, and nonnegative $\chi$ in steps varying by factors of 10 from 0.001 to 100 such that interpolation is possible, the tabulation being terminated where $p(\chi:\alpha,\beta)$ falls to 0.0001. The largest such value of $\chi$ is 338, for $\alpha = 0.25, \beta = -1.00$. Graphs of $p(\chi; \alpha, \beta)$ are also provided for essentially the above values of $\alpha$ and $\beta$. The methods of calculation (from the characteristic function), checking, and interpolation with respect to $\chi$, $\beta$, and (to some extent) $\alpha$ are described. The most important properties of stable distributions are summarized. Some applications are cited. A selected bibliography with 91 items is included.



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## 3.3. DIMENSIONS/NBS (Formerly Technical News Bulletin), ARTICLE TITLES ONLY

This monthly magazine is published to inform scientists, engineers, businessmen, industry, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on the work at NBS.

DIMENSIONS/NBS highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, DIMENSIONS/NBS reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing. Issued monthly.

### January 1973

**TNB 57,** No. 1, 1-24 (1973).

Key words: Measures for air quality; metric chart; rf measurements; runway capacities; semiconductor materials test; speed of light.

Superconducting Sensor Advances RF Metrology

Determining Runway Capacities and Delays

Nondestructive Test of Semiconductor Materials

The Environment and the Economy: Joint Progress or Parochial Negativism

Measures for Air Quality

Insert-NBS Measurement Seminars, 1973 Series

Experimental Measurement of Optical Frequency

New Value for Speed of Light

NSRDS News

Publications of the National Bureau of Standards

Prices Revised on Standard Reference Materials

### February 1973

**TNB 57,** No. 2, 25-52 (1973).

Key words: Cancer detection; city games; temperature scale; truck noise; waste incineration.

Cancer Detected in Living Animals Using Nuclear Magnetic Resonance

City Games People Play

NBS Measurements Show Significant Temperature Scale Differences

Optical Radiation News

The Metric System – A Changeover is Under Way

Brief History of Measurement Systems with a Chart of the Modernized Metric System

NBS Helps with Problems of Waste Incineration

NSRDS News

OIML Meeting

Publications of the National Bureau of Standards

### March 1973

**TNB 57,** No. 3, 53-76 (1973).

Key words: Electrical engineering units; electron recombination reactions; heat pipe oven; lead-based paints; popular metric chart; tribo-ellipsometry.

Electron Recombination Reactions

New NBS Director – Dr. Richard W. Roberts

New Oven Constrains Corrosive Vapors

Lower Temperatures Recommended for Ranges

Electrical Engineering Units and Constants Cards

Performance Standards for X-Ray Systems

NBS Aids U.S. Railroad System

NSRDS News

All You Will Need to Know About Metric

New Reference Tables for Low-Temperature Thermocouples Available

Using Tribo-Ellipsometry to Study Stress Corrosion Cracking

Standard Reference Material for Analyzing Lead-Based Paints Available

TV Time Petitions Sent to FCC

Publications of the National Bureau of Standards

### April 1973

**TNB 57,** No. 4, 77-100 (1973).

Key words: Electrical power; insulation of buildings; inventor; kitchen range standards; Shirley Highway bus project; superconductive fixed-point device.

NBS Evaluates Express Bus Project

Transition Temperatures Certified Using Superconductive Fixed- Point Device

Environmental Testing of Full Size Buildings

Optical Radiation News

New Kitchen Range Standards

Shunt Reactor Power Loss

NBS and the Inventor

NBS Signals Aid Power Companies

NBS Aids Hospital Designers

NSRDS News

Publications of the National Bureau of Standards

## May 1973

**TNB 57,** No. 5, 101-128 (1973).

Key words: Disaster losses; energy systems; flammable fabrics (FFACTS); metric; nuclear activation analysis; roofing systems; tooth decay.

The Metric Changeover

Recommendations to Cut Disaster Losses

The Ultimate Contribution of Nuclear Activation Analysis

Foam Polyurethane Roofing Systems

FFACTS

A New Theory of Tooth Decay

Matrix Isolation Studies of Reactive Species

Research Associate Develops Fire Test

A Look at Total Energy Systems

The NSRDS

Proposed Standard for Dense Numeric Representations

Publications of the National Bureau of Standards

## June 1973

**TNB 57,** No. 6, 139-152 (1973).

Key words: Child-proof matches; hydrogen arc radiometry; impact of Federal science; MHD materials research; musical foghorn; postal automation.

Postal Automation Commemorated

NBS Analyzes Human Factors in Post Office Operations

NBS Seeking "Child-Proof" Matches

SRM Benefits in "SOAP" Far Exceed Costs

NBS and the Return of the Musical Foghorn

Proceedings of the 5th Temperature Symposium Published

NBS Policy for Usage of SI Units

Golden Anniversary of WWV

Ongoing Magnetohydrodynamic (MHD) Materials Research

Hydrogen Arc Radiometry Applied to Fusion Effort

Research Associate Programs Continue Active

Impact of Federal Science on the National Economy (Abstract)

Optical Radiation News

Publications of the National Bureau of Standards

## July 1973

**TNB 57,** No. 7, 153-176 (1973).

Key words: Antenna performance; COBOL; environmental buoy cables; highway repair costs; incentives program; innovators; paper degradation; smoke test.

NBS Uses Laser to Detect Free Radicals

ASTM/NBS Symposium on Spreading Resistance Measurements

Initiation of Government-Wide Compiler Testing for COBOL

Bureau Studies VHF Antenna Performance Under Snow Conditions

New Technology Incentives Program Launched

Top Innovators Meet to Discuss Causes and Remedies

Accident Analysts: NBS Failure Sleuths Pick Up Pieces

Improved Atomic Frequency Standard Undergoing Tests

NBS Finds Way to Reduce U.S. Highway Repair Costs

New Environmental Buoy Cables Tested

NBS Smoke Test Gains Acceptance

NBS Finds Causes of Paper Degradation

Publications of the National Bureau of Standards

## August 1973

**DIM/NBS 57,** No. 8, 177-200 (1973).

Key words: Cryogenics; energy conservation; energy generation; household appliance energy labels; motor vehicles using dual-fuel systems; optical radiation news; standard gases.

To Our Readers

Energy and NBS

Energy Conservation in Buildings

Household Appliance Energy Labels

Energy Generation and Transmission

Liquefied Natural Gas and NBS

Comparative Performance of Motor Vehicles Operated on Gasoline, Compressed Natural Gas, and Propane

Three States Receive Weights and Measures Standards

Current Awareness in Cryogenics

Atomic Data Aid U.S. Fusion Efforts

Standard Gases for Automotive Emissions Analysis Now Available

Optical Radiation News

Highlights

Fabric Flammability Test to be Studied

Publications of the National Bureau of Standards

## September 1973

**DIM/NBS 57**, No. 9, 201-224 (1973).

Key words: Art; clinical chemistry; fire services; high-accuracy mass spectrometry; materials failure; night vision; precision; surface roughness.

Science Aids Art World

New Way to Predict Materials Failure

Nation's Fire Services Program Strengthened

Highlights

Pollution-Measuring Device Developed

NBS Aids Night Vision Market

Weights, Measures, and the New Equity

Product Information Guide Published

Picosecond-Pulse Precision Improved

New Clinical Chemistry Program Announced

Microcalorimetry Applied to Clinical Chemistry

Computerized System Measures Surface Roughness

Plastic Jerry-Can Standard Recommended

Extra Dense Lead Glass Standard Issued

ARPA/NBS Semiconductor Workshop Held

Publications

## October 1973

**DIM/NBS 57**, No. 10, 225-252 (1973).

Key words: Air pollution; air quality; auto emissions; clean air and water; environmental quality; metal contaminants; occupation-related air pollutants; oil spills; radioactive pollutants; stratospheric air pollution; water quality; water pollution.

Measuring Environmental Quality

Clean Air and Water

Measuring Auto Emissions

Air Quality

Occupation-Related Air Pollutants

Techniques and Equipment

Stratospheric Air Pollution

Standard Reference Pollutants

Activity of Radioactive Gases

Water Quality

Trace Metal Contaminants

Radioactive Pollutants

Highlights

Publications of the National Bureau of Standards

## November 1973

**DIM/NBS 57**, No. 11, 253-276 (1973).

Key words: Clinical SRM's; distance to moon; energy; fire technology; invisible moonlight; iodine stabilized lasers; sensor progress.

How High the Moon

NBS Experts Developing Ultrasound Standards

Harnessing Invisible Moonlight

The Energy Complex—Target for Today's Technology

Highlights

America's Not for Burning

New Director of NBS Fire Program

NBS Promoting Use and Development of Fire-Safe Clothing

Fire: Human Action and Reaction

New Clinical Standard Reference Materials Available

NBS Reports Sensor Progress

Calibration of Quartz Control Plates

NBS to Exploit Iodine Stabilized Lasers

Publications

## December 1973

**DIM/NBS 57**, No. 12, 277-300 (1973).

Key words: Air pollutants; automation technology; computer software; computer standards; computer utilization; electron spectroscopy; humidity facility; international trade; shortest path studies.

Computer Technology and NBS

Automation Technology

Improving Computer Utilization

Computers in International Trade

Shortest Path Studies: How to Get There Efficiently

Computer Standards—Measures for Compatibility and Effectiveness

WWV/WWVH Time Designation Change

Highlights

Starry-Eyed NBS'ers Do the Unusual

Facility Generates Parts Per Billion Humidity

Air Pollutants Measured Using Electron Spectroscopy

Publications

Index

## 3.4. MONOGRAPHS

Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Monogr. 126. **Platinum resistance thermometry,** J. L. Riddle, G. T. Furukawa, and H. H. Plumb, Nat. Bur. Stand. (U.S.), Monogr. 126, 129 pages (Apr. 1973) $2.10, SD Catalog No. C13.44:126.

Key words: Calibration; calibration errors; cryostat; fixed points; freezing point; International Practical Temperature Scale; platinum resistance thermometer; Thermodynamic Temperature Scale; thermometry; triple point.

The monograph describes the methods and equipment employed at the National Bureau of Standards for calibrating standard platinum resistance thermometers (SPRT) on the International Practical Temperature Scale (IPTS-68). The official text of the scale is clarified and characteristics of the scale are described. Several designs of SPRT's are shown and discussed in the light of the requirements and recommendations on the text of the IPTS-68. Possible sources of error such as those due to the internal and external self-heating effects and the immersion characteristics of SPRT's are described in detail. Precautions and limitations for the mechanical and thermal treatment and for the shipment of SPRT's are indicated, and a guide is given for those desiring the thermometer calibration services of NBS. The description of equipment employed at the National Bureau of Standards for maintaining the IPTS-68 includes the triple point of water cell, tin point cell, zinc point cell, oxygen normal boiling point comparison cryostat, the 13 to 90 K comparison cryostat, and the reference SPRT's upon which the NBS- IPTS-68 in the region 13 to 90 K is based. Methods are given for calculating temperatures from the calibration data and observed resistances; the propagation of calibration errors is discussed. Supplemental information given in the Appendixes includes the authorized English version of the text of the IPTS-68, tabular values of the "reference function" used below 0 °C, tabular values of the differences between IPTS-68 and IPTS-48, analysis of the first derivatives at 0 °C of the IPTS-68 formulations, methods for calibrating potentiometers and Mueller bridges, and the derivation of the coefficients used in the analysis of error propagation.

Monogr. 130. **The divergent beam (Kossel) x-ray method and its uses in measuring strain contours in an individual grain of Fe-3 weight percent Si transformer sheet,** H. Yakowitz, Nat. Bur. Stand. (U.S.), Monogr. 130, 80 pages (Aug. 1973) 95 cents, SD Catalog No. C13.44:130.

Key words: Divergent beam x-ray diffraction; electron probe microanalysis; iron-silicon alloy; Kossel; strain; stress; transformer sheet.

Residual and impressed stresses and strains in Fe-3 wt. pct. Si alloy transformer sheet were studied. Results were obtained by the divergent beam (Kossel) x-ray microdiffraction techniques. The optically opaque Fe-3 wt. pct. Si alloy was mapped for residual and impressed stresses and strains. These maps are roughly analogous to polarized light stress analysis of transparent materials. The results showed that a variable strain distribution existed in the alloy sheet at the time it was ready for insertion into a transformer core. Small applied compressive and tensile loads tended to rearrange this variable strain distribution but not to appreciably alter the total stored elastic energy.

Monogr. 131. **Thermal conductivity of solids at room temperature and below. A review and compilation of the literature,** G. E. Childs, L. J. Ericks, and R. L. Powell, Nat. Bur. Stand. (U.S.), Monogr. 131, 624 pages (Sept. 1973) $7.80, SD Catalog No. C13.44:131.

Key words: Cryogenic thermal conductivity; elements, alloys, commercial metals, semiconductors, semimetals, ionic and valence crystals, minerals, molecular crystals, polymers, glasses, disordered dielectrics, thermal conductivity of; review; thermal conductivity.

An extensive compilation is given of the measured values of thermal conductivity for nearly all solid materials from room temperature down to 0.01 kelvin. The reviewed materials include elements, alloys and commercial metals, semiconductors, semimetals, ionic and valence crystals, minerals, molecular crystals, polymers, glasses, and disordered dielectrics. Excluded are foams, powders, earths, fibers, layers of composites, and similar other heterogeneous solids. Data for temperatures below 1 kelvin are presented separately. The tables and graphs are complete for literature references from 1900 to mid-1971. Experimental methods and physical phenomena are discussed in the text and coded in the tables for references for which curves are shown. Supersedes NBS Circular 556.

Monogr. 132. **A compilation and evaluation of mechanical, thermal, and electrical properties of selected polymers,** R. E. Schramm, A. F. Clark, and R. P. Reed, Nat. Bur. Stand. (U.S.), Monogr. 132, 848 pages (Sept. 1973) $10.25, SD Catalog No. C13.44:132.

Key words: Compilation; electrical properties; mechanical properties; plastics; polymers; thermal properties.

This compilation abstracts original experimental data on the mechanical, thermal, and electrical properties of six commercially available polymers. After an extensive review of the open literature, all available data were collected together in graphical and tabular form along with material characterization, experimental method, and reference to the original publication. The data are also summarized and a brief description of each polymer is included.

Monogr. 134. **Space groups and lattice complexes,** W. Fisher, H. Burzlaff, E. Hellner, and J. D. H. Donnay, Nat. Bur. Stand. (U.S.), Monogr. 134, 184 pages (May 1973) $4.10, SD Catalog No. C13.44:134.

Key words: Crystallography; crystal point groups; crystal structure; lattice complexes; site sets; space groups.

The lattice complex is to the space group what the site set is to the point group—an assemblage of symmetry-related equivalent points. The symbolism introduced by Carl Hermann has been revised and extended. A total of 402 lattice complexes are derived from 67 Weissenberg complexes. The Tables list site sets and lattice complexes in standard and alternate representations. They answer the following questions: What are the coordinates of the points in a given lattice complex? In which space groups can a given lattice complex occur? What are the lattice complexes that can occur in a given space group? The higher the symmetry of the crystal structures is, the more useful the lattice-complex approach should be on the road to the ultimate goal of their classification.

Monogr. 135. **Properties of glasses in some ternary systems containing BaO and $SiO_2$,** G. W. Cleek and C. L. Babcock, Nat.

Bur. Stand. (U.S.), Monogr. 135, 42 pages (Sept. 1973) 70 cents, SD Catalog No. C13.44:135.

Key words: Barium glasses; barium silicates; glass properties; glass property factors; oxide glasses; silicate substructures; ternary glasses.

The glass forming regions in six ternary oxide systems containing BaO, $SiO_2$ and a third oxide have been determined. The properties of the resulting glasses were measured and the results are reported. The data on refractive indices, dispersions and specific volumes were evaluated by computer methods in an attempt to identify "substructures" containing the cations present in the glasses.

Monogr. 136. **Graphical recoupling of angular momenta,** D. R. Lehman and J. S. O'Connell, Nat. Bur. Stand. (U.S.), Monogr. 136, 18 pages (Oct. 1973) 50 cents, SD Catalog No. C13.44:136.

Key words: Angular momentum; diagrams; graphs; quantum theory; recouping; transformation theory.

A diagrammatic method for solving angular momentum recoupling problems is presented. It is shown that a few graphical elements with a set of rules for their use lead to the solution of many types of recoupling problems in an intuitive and systematic way. Several examples are given together with exercise to develop the reader's facility with the method.

Monogr. 137. **Applications of waveguide and circuit theory to the development of accurate microwave measurement methods and standards,** R. W. Beatty, Nat. Bur. Stand. (U.S.), Monogr. 137, 322 pages (Aug. 1973) $5.20, SD Catalog No. C13.44:137.

Key words: Attenuation definitions; attenuation measurement; barretter mount efficiency; coaxial connectors; impedance measurement; microwave network theory; mismatch errors; phase shift-measurement; power measurement; reflectometers; waveguide joints; waveguide theory.

The basic theory and analytical methods used in the development of accurate microwave measurement methods and standards are presented.

Developments at the U.S. National Bureau of Standards during 1948-1968 are described in which the above theory and analytical methods were applied.

These developments were in the fields of power, impedance, attenuation and phase shift, and led to the establishment of National Standards and calibration methods at frequencies from about 300 MHz to 30 GHz.

## 3.5. HANDBOOKS

Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

H112. **Examination procedure outlines for commercial weighing and measuring devices. A manual for weights and measures officials,** O. K. Warnlof, Nat. Bur. Stand. (U.S.), Handb. 112, 89 pages (June 1973) $1.10, SD Catalog No. C13.11:112.

Key words: Codes; examination procedure; inspection; meters; outlines; scales; tests.

This handbook presents an operational guide for the field examination of commercial weighing and measuring devices. It includes inspection and test procedures, with code references to National Bureau of Standards Handbook 44, Fourth Edition, "Specifications, Tolerances, and Technical Requirements for Commercial Weighing and Measuring Devices."

## 3.6. SPECIAL PUBLICATIONS

Includes proceedings of high-level national and international conferences sponsored by NBS, precision measurement and calibration volumes, NBS annual reports, and other special publications appropriate to this grouping, such as wall charts and bibliographies.

SP236, 1973 Edition. **NBS frequency and time broadcast services, radio stations WWV, WWVH, WWVB, and WWVL,** P. P. Viezbicke, Editor, Nat. Bur. Stand. (U.S.), Spec. Publ. 236, 1973 Edition, 19 pages (May 1973) 45 cents, SD Catalog No. C13.10:236, 1973 Edition.

Key words: Broadcast of standard frequencies; high frequency; low frequency; standard frequencies; time signals; very low frequency.

Detailed descriptions are given of the technical services provided by the National Bureau of Standards radio stations WWV, WWVH, WWVB, and WWVL. These services are: 1. Standard radio frequencies; 2. Standard audio frequencies; 3. Standard musical pitch; 4. Standard time intervals; 5. Time signals; 6. UTI corrections; and 7. Official announcements. In order to provide users with the best possible services, occasional changes in broadcasting schedules are required. This publication shows the schedules in effect on January 1, 1973. Annual revisions will be made. Current data relating to standard frequencies and time signals are available monthly in the Time and Frequency Services Bulletin. Advance notices of changes occurring between revisions will be sent to users of NBS broadcast services who request such notice on the basis of need. Supersedes NBS Special Publication 236, 1972 and previous editions.

SP260, 1973 Edition. **Standard reference materials 1973 catalog,** Nat. Bur. Stand. (U.S.), Spec. Publ. 260-1973 catalog, 96 pages (Apr. 1973) $1.25, SD Catalog No. C13.10:260-1973 cat.

Key words: Analysis; characterization, composition; General Materials; properties; Research Materials; Standard Reference Materials.

This Catalog lists and describes the Standard Reference Materials (SRM's), Research Materials (RM's), and General Materials (GM's) currently distributed by the National Bureau of Standards, as well as many of the materials currently in preparation. SRM's are used to calibrate measurement systems and to provide a central basis for uniformity and accuracy of measurement. The unit and quantity, the type, and the certified characterization are listed for each SRM, as well as directions for ordering. The RM's are not certified, but are issued to meet the needs of scientists engaged in materials research. RM's are issued with a "Report of Investigation," the sole authority of which is the author of the report. The GM's are standardized by some other agency other than NBS. NBS acts only as a distribution point and does not participate in the standardization of these materials. Announcements of new and renewal SRM's, RM's, and GM's are made in the semi-annual supplements to this Catalog, SRM Price and Availability List, the NBS Technical News Bulletin, and in scientific and trade journals. Supersedes NBS Special Publication 260, 1970 Edition.

SP260-32. **Standard reference materials: Standard quartz cuvettes for high accuracy spectrophotometry,** R. Mavrodineanu and J. W. Lazar, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-32, 27 pages (Dec. 1973) 55 cents, SD Catalog No. C13.10:260-32.

Key words: Cuvette, spectrophotometry; lightpath; pathlength; quartz, cuvette; radiation pathlength.

Accurate knowledge of lightpath and parallelism of cuvettes used in spectrophotometry is one of the indispensable parameters which must be determined when accurate transmittance measurements of liquid materials is considered. A description is given of the design and techniques developed at NBS for the production of quartz cuvettes having a nominal radiation pathlength of 10 mm $\pm$ 0.03 mm and a parallelism certified both with an uncertainty of $\pm$ 0.0005 mm. The method and instrumentation used to determine these parameters is also described in the paper.

SP260-45. **Standard reference materials: Development of NBS Standard Reference Material No. 1579 Powdered Lead-Based Paint,** B. Greifer, E. J. Maienthal, T. C. Rains, and S. D. Rasberry, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-45, 31 pages (Mar. 1973) 50 cents, SD Catalog No. C13.10:260-45.

Key words: Analytical standard; atomic absorption spectrometry; differential cathode ray polarography; electrodeposition; lead-based paint; neutron activation analysis; x-ray fluorescence spectrometry; Standard Reference Material.

The development of NBS Standard Reference Material No. 1579, Powdered Lead-Based Paint is described. This SRM is intended for use in the calibration of apparatus and methods used in determining lead in paint removed from old housing.

Paints scraped from the interior surfaces of old housing were collected, blended, homogenized, and characterized for lead content. The average lead content was found to be 11.87 $\pm$ 0.04 percent lead by weight determined by atomic absorption spectrometry and by differential cathode ray polarography.

The analytical procedures involved sample dissolution by dry ashing in a furnace at 450-550 °C followed by exhaustive extractions of the insoluble residue with acids and with ammonium acetate solution.

SP300. Volume 10. **Precision measurement and calibration. Selected NBS papers on image optics,** C. S. McCamy, Editor, Nat. Bur. Stand. (U.S.), Spec. Publ. 300, Vol. 10, 953 pages (Nov. 1972) $11.10, SD Catalog No. C13.10:300, Vol. 10.

Key words: Camera calibration; image evaluation; image optics; image stability; interferometry; lens testing; light filters; light sources; photography.

This volume is one of an extended series which brings together the previously published papers, monographs, abstracts, and bibliographies by NBS authors dealing with precision measurement of specific physical quantities and the calibration of the related metrology equipment. The contents have been selected as being useful to the standards laboratories of the United States in tracing to NBS standards the accuracies of measurement needed for research work, factory production, or field evaluation.

Volume 10 deals with image optics, including photography. It contains 57 reprints assembled in 4 sections: (1) Refractometry and Optical Homogeneity: (2) Interferometry in Image Optics; (3) Optical Image Evaluation; (4) Photography. Each section is introduced by an interpretive foreword, including in some instances, pertinent references.

SP305. Supplement 4. **Publications of the National Bureau of**

**Standards 1972 catalog. A compilation of abstracts and key word and author indexes,** B. L. Oberholtzer, Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 4, 449 pages (July 1973) $3.75, SD Catalog No. C13.10:305 Suppl. 4.

Key words: Abstracts, NBS publications; key words; publications.

This supplement to Special Publication 305 Supplements 1, 2, and 3 of the National Bureau of Standards lists the publications of the Bureau issued between January 1, 1972 and December 31, 1972. It includes an abstract of each publication (plus some earlier papers omitted from Special Publication 305 Supplement 3), key-word and author indexes; and general information and instructions about NBS publications.

Miscellaneous Publication 240 (covering the period July 1, 1957 through June 30, 1960) and its supplement (covering the period July 1, 1960 through June 30, 1966), Special Publication 305 (covering the period July 1966 through December 1967) and Special Publication 305 Supplement 1 (covering the period 1968-1969), Special Publication 305 Supplement 2 (covering the period 1970), and Special Publication 305 Supplement 3 (covering the period 1971) remain in effect. Two earlier lists, Circular 460 (Publications of the National Bureau of Standards, 1901 to June 1947) and its supplement (Supplementary List of Publications of the National Bureau of Standards, July 1, 1947 to June 30, 1957) are also still in effect.

SP320. Supplement 2. **Bibliography on atomic transition probabilities July 1971 through June 1973,** J. R. Fuhr and W. L. Wiese, Nat. Bur. Stand. (U.S.), Spec. Publ. 320 Suppl. 2, 63 pages (Nov. 1973) 95 cents, SD Catalog No. C13.10:320.

Key words: Allowed; atomic; discrete; forbidden; transition probability.

This is the second supplement to the NBS Special Publication 320, "Bibliography on Atomic Transition Probabilities," and it covers the most recent literature on the subject from July 1971 through June 1973. The papers are arranged according to elements and stages of ionization, and the method employed and classification of transitions are indicated for each reference. Only articles on discrete transitions, both allowed and forbidden, are listed. Papers containing data for many elements within isoelectronic sequences are collected separately in front of the list in order to keep this bibliography to a reasonable size. Also included is a selected list of new papers dealing with the subject of atomic transition probabilities from a general point of view.

SP370. **Research and testing facilities of the Engineering Mechanics Section, National Bureau of Standards, Washington,** D.C., by the Staff of the NBS Engineering Mechanics Section, D. J. Chwirut, Coordinator, Nat. Bur. Stand. (U.S.), Spec. Publ. 370, 23 pages (Jan. 1973) 55 cents, SD Catalog No. C13.10:370.

Key words: Engineering Mechanics Section; force generating equipment; research facilities; testing machines.

The principal characteristics of the force measuring and generating equipment and related research facilities available in the Engineering Mechanics Section of the National Bureau of Standards are described.

SP371. **A supplementary bibliography of kinetic data on gas phase reactions of nitrogen, oxygen, and nitrogen oxides,** F. Westley, Nat. Bur. Stand. (U.S.), Spec. Publ. 371, 92 pages (Feb. 1973) $1.25, SD Catalog No. C13.10:371.

Key words: Bibliography; chemical kinetics; excited state; gas phase; nitrogen atom; nitrogen molecule; nitrogen oxides; oxygen atom; oxygen molecule; ozone.

A bibliography, a reaction-oriented list of references supplementing NBS publication COM-71-00841 (NBS-OSRDB-71-2, August 1971), is provided for published papers and reports containing rate data for reactions of N, $N_2$, $N_3$, $N_2O$, $N_2O_2$, $N_2O_3$, $N_2O_4$, $N_2O_5$, NO, $NO_2$, $NO_3$, $NO_4$, O, $O_2$ and $O_3$ with each other. It includes an extensive list of papers dealing with production and reactions of molecular oxygen in excited singlet state ($a^1\Delta_g$, $b^1\Sigma_g^+$, $c^1\Sigma_u$). In addition, two lists of critical reviews dealing with the above reactions are included. About 500 papers are listed. The period covered extends from 1900 through January 1972.

SP374. **Method for determining the resolving power of photographic lenses,** F. E. Washer and I. C. Gardner. Appendix added by C. E. Kuyatt, Nat. Bur. Stand. (U.S.), Spec. Publ. 374, 32 pages (June 1973) $3.00, SD Catalog No. C13.10:374.

Key words: Photographic lenses; resolution test charts; resolving power.

This publication supersedes NBS Circular 533, issued May 20, 1953. It contains the original data and a new appendix describing the NBS Microcopy Resolution Test Charts No. 1010a. It provides the photographer with two sets of charts by which the resolving power of a photographic lens may be numerically measured with respect to a definite scale of values. A detailed description is given of the procedure and technique to be followed in order that comparable values may be obtained by different observers. The test provides an objective method of testing a photographic lens. The six charts of one set are printed in black on a white background to form a high-contrast chart. The six charts of the other set are printed with gray ink on a gray background to form a low-contrast chart. Additional uses of these charts are also described. These uses include the testing of goggle lenses for definition and prismatic power and the testing of telescopes and binoculars for definition. Supersedes NBS Circular 533, issued May 1953.

SP375. **An index of State specifications and standards, covering those standards and specifications issued by State Purchasing Offices of the United States,** L. L. Grossnickle, Editor, Nat. Bur. Stand. (U.S.), Spec. Publ. 375, 394 pages (Sept. 1973) $3.70, SD Catalog No. C13.10:375.

Key words: Index of State specifications and standards; Key-Word-In-Context index of State specifications and standards; purchase specifications and standards, State; specifications, State; standards, State; State specifications and standards.

This computer-produced Index contains the permuted titles of more than 6,000 State purchasing specifications and standards issued by 37 State Purchasing Offices thru 1971. The title of each specification and standard can be found under all the significant key words which it contains. These key words are arranged alphabetically down the center of each page together with their surrounding context. The date of publication or latest revision, the specification or standard number, and an abbreviation for each State appear as part of each entry. A list of these abbreviations and the names and addresses of the State Purchasing Officials are found at the beginning of the Index.

SP377. **Index to the reports of the National Conference on Weights and Measures. From the First to the Fifty-sixth 1905 to 1971,** F. C. Bell, Nat. Bur. Stand. (U.S.), Spec. Publ. 377, 46 pages (Feb. 1973) 75 cents, SD Catalog No. C13.10:377.

Key words: Index; measures; National Conference; reports; weights.

This publication comprises a subject index and a speaker index for the Reports of the National Conference on Weights

and Measures from the First (1905) through the Fifty-Sixth (1971). Supersedes Miscellaneous Publication 243.

SP378. **Accuracy in spectrophotometry and luminescence measurements,** Proc. Conf. held at the National Bureau of Standards, Gaithersburg, Md., Mar. 22-24, 1972, R. Mavrodineanu, J. I. Shultz, and O. Menis, Editors, Nat. Bur. Stand. (U.S.), Spec. Publ. 378, 268 pages (May 1973) $4.85, SD Catalog No. C13.10:378.

Key words: Accuracy; critical parameters; instrumentation; linearity; quantum efficiency; spectrofluorometry; spectrophotometry; standards.

This volume contains the 18 papers presented at the Conference on Accuracy in Spectrophotometry and Luminescence Measurements organized by the Analytical Chemistry Division of the National Bureau of Standards and held from March 22 to 24, 1972.

These papers discuss the problems encountered in accurate spectrophotometry and luminescence measurements of materials. They also define the status of these competences from the standpoint of basic principles, critical factors involved in the measurements, and the instrumental conditions which must be fulfilled to assure accurate measurements. Particular attention is given to the selection, production and use of Standard Reference Materials in spectrophotometry and spectrofluorometry. Problems related to health are also covered in six of the papers, two of which include original contributions to the application of luminescence techniques to specific biochemical problems.

Reprinted from the National Bureau of Standards Journal of Research, Section A. Physics and Chemistry, Vol. 76A, Nos. 5 and 6, Sept.-Oct., and Nov.-Dec. 1972. *These proceedings include the following papers (indented):*

**High accuracy spectrophotometry at the National Physical Laboratory,** F. J. J. Clarke, *SP378,* pp. 1-29 (May 1973).

Key words: High accuracy spectrophotometry; photoelectronic linearity; reflectance; transmittance.

The techniques and equipment used at the National Physical Laboratory (NPL) to achieve high accuracy spectrophotometric measurements are described and discussed. The emphasis at NPL has always been on the determination of systematic components of error and their elimination or correction rather than on the attainment of mere precision, which is largely a matter of variance and resolution. The scales of regular transmittance, diffuse transmittance, total transmittance of scattering samples, regular reflectance, diffuse reflectance, total reflectance and radiance factor are determined, maintained, and made available in practical form to industry by combined use of a reference NPL manual spectrophotometer and commercial recording spectrophotometers.

The presentation will concentrate on transmittance measurements made with the reference instrument, which is designed specifically to allow separate investigation of the various possible sources of systematic error, processes that are not practicable with commercial spectrophotometers. The investigation of the linearity of the complete photoelectronic system has always been a key factor, and double-aperture devices have been used consistently at NPL for over 40 years to monitor the performance of this instrument and its predecessors. Besides instrumentation, the procurement of material standards of suitable quality is a major limitation of the art, and the types in use at NPL are described, including the recently developed Ceramic Colour Standards.

**An accurate spectrophotometer for measuring the transmittance of solid and liquid materials,** R. Mavrodineanu, *SP378,* pp. 31-51 (May 1973).

Key words: Absorbance; automation of accurate spectrophotometer; instrumentation, spectrophotometric; spectrophotometry, high accuracy; standard reference material in spectrophotometry; transmittance.

The optical transmittance of solids and liquids as well as the molar absorptivity of various chemical species are parameters of fundamental significance in characterizing these materials. Meaningful transmittance data can be obtained only when the measurements are performed with well-known accuracy and precision. To perform such measurements, a high accuracy spectrophotometer was designed and assembled at NBS, Analytical Chemistry Division, and will be described in this paper. This single-beam instrument is composed of a constant radiation source, a monochromator, a sample carriage, an integrating sphere-photomultiplier assembly followed by appropriate electronics, and a read out system consisting of a digital voltmeter and a computer data acquisition and handling provision. The accuracy of transmittance measurements is determined by the light-addition principle used in conjunction with a two-aperture arrangement. The spectrophotometer can be used in manual or automatic modes of operation. A detailed discussion of the data obtained with this instrument, used in both modes, will be presented together with its application to the certification of solid and liquid Standard Reference Materials for checking the photometric scales of conventional spectrophotometers.

**Absolute spectroradiometric measurements,** G. A. W. Rutgers, *SP378,* pp. 53-62 (May 1973).

Key words: Absolute spectroradiometry; absolute standard source of radiation; calibrated photodetector.

There are two general methods for measuring a quantity of radiation emitted by a source. One can compare it with the radiation emitted by a standard source or one can measure the radiation with a detector calibrated in absolute units. When using the latter method, one must know the spectral transmittance factor of the optical components between source and detector.

In the present paper, a survey will be given of the standard sources available for spectroradiometry: cavity radiator, tungsten strip lamp, anode of the carbon arc, xenon arc and cascade arc. Several types of detectors such as the absolute bolometer and thermopile, with their properties, will be discussed.

**Accurate measurements of and corrections for nonlinearities in radiometers,** C. L. Sanders, *SP378,* pp. 63-79 (May 1973).

Key words: Nonlinearity; photocell linearity; photometric accuracy; radiation addition method.

The methods described in the literature for accurately measuring photocell linearity are surveyed and assessed. The effect of not measuring photocell linearity under the conditions used in the final apparatus are considered. Some of the conditions necessary for accurate assessment of the nonlinearity under working conditions are specified. The use of the NRC "Photocell Linearity Tester" to measure and correct for the nonlinearity of various receivers is described.

**Physical parameters in high-accuracy spectrophotometry,** K. D. Mielenz, *SP378,* pp. 81-93 (May 1973).

Key words: High accuracy spectrophotometry, physical

parameters; linearity test of photodetector; spectrophotometry, high accuracy.

The measured apparent transmittance $T_A$ of a filter or liquid sample depends on the beam geometry in the spectrophotometer. For focused light incident upon the sample, $T_A$ is different for systems having different f-numbers, and also depends on the state of polarization of the light. These effects are eliminated when the incident light is collimated; in this case $T_A$ approaches the "true" transmittance $\tau$ of the sample. Both modes of operation suffer from stray light and interference effects. The former may be reduced significantly by using mirror rather than lens optics, and the latter by suitable choice of the monochromator slit width. A new spectrophotometer based upon the above-mentioned design principles is described. The photometric precision of this instrument is shot-noise limited, permitting measurements to better than $10^{-4}$ transmittance units.

The double-aperture method of testing detector linearity to this level of precision is discussed. The conventional method of finding the nonlinearity correction can be replaced by a curve-fitting procedure giving better precision. Data on detector nonlinearity, and its dependence on wavelength, are presented.

**Liquid absorbance standards,** R. W. Burke, E. R. Deardorff, and O. Menis, *SP378,* pp. 95-108 (May 1973).

Key words: Absorptivity data; accuracy; liquid absorbance standards; Standard Reference Materials.

Errors in the measurement of the absorbances of liquid filters result from instrumental and chemical uncertainties. This paper presents a systematic study of these variables on the absorbances of selected filters. Three types of liquid filters are discussed. These are (1) individual solutions of high purity compounds, (2) composite mixtures, and (3) aqueous solutions of organic dyes. The accuracy of the absorptivity data is established using NBS-calibrated glass filters. The magnitude of the errors arising from spectral bandpass, beam geometry, stray light, internal multiple reflections, and refractive index are delineated. Finally, as a practical outgrowth of this study, the development and issuance of NBS Standard Reference Material 931, Liquid Absorbance Standards for Ultraviolet and Visible Spectrophotometry, is described.

**Accurate measurement of molar absorptivities,** R. W. Burnett, *SP378,* pp. 109-115 (May 1973).

Key words: Molar absorptivity in clinical chemistry; random errors in molar absorptivity; systematic errors in molar absorptivity.

The key to accurate measurement of molar absorptivities is a thorough understanding of the sources of error which appear throughout the measurement procedure. Sources of determinant error will be listed with comments on estimating their magnitude and eliminating them where possible. Sources of random error will be discussed as well as the propagation of both random and determinant errors. There is discussion of the need for accurate values of molar absorptivities using examples from clinical chemistry. Finally, the proper use of accurate absorptivity values in the clinical chemistry laboratory will be considered. Here, emphasis is on the need for a quality assurance system which includes routine checks on such things as wavelength calibration and photometric accuracy of spectrophotometers, calibration of analytical balances, and quality of incoming reagents.

**Problems associated with the need for standardization in clinical spectrophotometric and fluorometeric measurements,** J. R. Penton, G. M. Widdowson, and G. Z. Williams, *SP378,* pp. 117-124 (May 1973).

Key words: Clinical standards; standard reference materials; standardization, spectrofluorometric; standardization, spectrophotometric.

There is a growing demand in clinical chemistry for analyses to be performed in a manner allowing comparisons of results among laboratories and, from time to time, in the same laboratory. Reliable comparability requires adequate procedures of standardization for spectrophotometric and fluorometric instruments and methods. Problems with chemical and instrumental standardization are discussed.

For assays where the substance to be measured is available in suitable form, primary chemical standardization is justifiably popular. Relatively unsophisticated instrumentation can be used to compare measurements of unknown samples with such standards. Because primary standards meeting all necessary criteria are not available for many assays of clinical significance, standardization must depend on precision and accuracy of the instrumentation used, and on accurately compiled values of chemical-optical properties for the materials of interest. The task of compilation is outside the capability of the routine laboratory and should be provided by a reliable central agency. If an individual laboratory is to use the agency's compiled values, that laboratory must have available precise, accurate and reasonably inexpensive instrumentation along with reliable absorbance, fluorescence, and wavelength calibration standards.

**The role of spectrophotometric standards in the clinical chemistry laboratory,** R. N. Rand, *SP378,* pp. 125-134 (May 1973).

Key words: Clinical spectrophotometry, accuracy, precision; optical cuvettes; spectrophotometric standards, clinical.

It is obvious that erroneous data reported to a physician may adversely affect patient welfare. Currently, acceptable limits of accuracy and precision are poorly defined. It should be recognized, however, that the spectrophotometric measurement step in an appropriate analytical procedure is critical and inapparent error may occur. Spectrophotometric measurements, both manual and automated, are extensively used in the clinical chemistry laboratory. At least 1,000,000 such measurements per day on rather diverse equipment are made in this country; yet, few standards exist. Results of intra-lab surveys suggests that performance could be improved. The various ways in which spectrophotometry is used will be illustrated and a discussion of possible errors resulting from nonstandardized instrumentation will follow. There is pressing need for well defined and easily usable standards for wavelength, photometric accuracy, photometric linearity, stray light, as well as NBS specifications for optical cuvettes.

**Spectrophotometric standards,** W. H. Venable, Jr., *SP378,* pp. 135-136 (May 1973).

Key words: Photometric accuracy; standards, spectrophotometric.

To be useful, spectrophotometric measurements must be believable and practical. The basic standard for any believable spectrophotometric measurement is the ability to accurately compare fluxes of radiation within the framework of a well-defined geometry. The emphasis in the program proposed for the Institute for Basic Standards is to develop such ability over the broadest range of spectrophotometric

measurements. Establishing such a basis will enable the National Bureau of Standards to render real assistance to those who deal with the problem of making practical measurements.

**Absolute spectrofluorometry,** W. H. Melhuish, *SP378,* pp. 137-150 (May 1973).

Key words: Actinometers; calibration of spectrofluorometers; detectors, absolute; fluorescence spectra, corrected; quantum counters; spectrofluorometers, design; spectrofluorometry, absolute; standard lamps; standards, fluorescence; thermopiles.

The last 10 years has seen the increasing publication of the emission spectra of organic, inorganic and metal-chelate compounds, but there is no agreed method of presentation of such spectra. In the few cases where corrected emission spectra have been published, there is often no mention of the units used for the intensity coordinate or the method used for correcting spectra. A method of reporting absolute fluorescence spectra originally put forward in 1962 will be reexamined and improved. The two best known methods for calibrating spectrometers for absolute spectrofluorometry: (a) standard tungsten lamp, (b) quantum counter method, will be critically examined, and the limitations and possible improvements in accuracy will be proposed. The criteria for an emission standard will be examined and the use of emission standards for calibrating spectrofluorometers discussed. It is suggested that the distribution of emission standards to laboratories measuring corrected fluorescence spectra and the analysis and publication of the results should be done in the near future.

**Absolute quantum efficiencies,** G. A. Crosby, J. N. Demas, and J. B. Callis, *SP378,* pp. 151-167 (May 1973).

Key words: Calorimetry in quantum yields; laser, use in quantum yields; photodetectors in quantum yields; quantum efficiencies.

Recent developments in several areas of chemistry, laser technology, photodetector instrumentation, and calorimetry are surveyed, and their probable impact on the measurement of quantum yields is assessed. Chemical developments include: (a) synthesis and design of new luminescent molecules that could possibly serve as standards, (b) application of improved separation techniques to provide samples of extreme purity, and (c) advances in photochemistry that portend the development of wide-range chemical actinometers. The potential use of lasers in quantum-yield measurements and their advantages over conventional sources for application in both optical and calorimetric techniques are pointed out. New methods of quantum-yield measurements, based on the novel characteristics of laser pump sources, are suggested, including the feasibility of measuring yields under time-resolved conditions and of employing internal standards. The possible lifting of wavelength restrictions on both laser sources and detector devices and the implications of these developments for extending the spectral range of quantum-yield measurements are discussed. The current status of calorimetry for determining yields is surveyed, and the impact of recent technology on the feasibility of developing calorimetric methods competitive with optical methods is assessed.

**Phosphorimetry,** J. D. Winefordner, *SP378,* pp. 169-182 (May 1973).

Key words: Aqueous solvents in phosphorimetry; phosphorimetry; rotating capillary cell; solvents for phosphorimetry.

Phosphorimetry in the past has received limited use because the precision of reproducibility was inadequate, there were solvent limitations, and preparation of test specimens was difficult and time consuming. Detection limits have now been lowered by more than two orders of magnitude by using a rotating capillary sample cell, a more stable excitation-source power supply, and aqueous solvents. These steps have also increased precision by more than an order of magnitude. Considerable reduction in time and effort of sampling and measurement has been effected compared to phosphorimetric measurements made with standard procedures and commercial equipment. Twenty microliters of aqueous solution is all that is required to fill a quartz capillary cell by capillary action. Capillary cells filled with aqueous solutions do not crack when cooled to 77 K or when returned to room temperature. Rotation of the sample cell minimizes effects due to cell orientation and thus improves precision. Reduction of background phosphorescence results in improved accuracy of analysis. A study was made of the influence of methanol-water mixtures and of sodium-halide aqueous solutions on the magnitude of phosphorescence signals from several substances and of the effect on signal-to-noise ratios. The optimum solvent system for many phosphorimetric measurements is discussed. Analytical results are given for several organic substances measured by phosphorimetry at 77 K. These results are compared with those from previous studies by older methods.

**Measurements of absolute values in biochemical fluorescence spectroscopy,** R. F. Chen, *SP378,* pp. 183-196 (May 1973).

Key words: Absolute fluorometry; absolute fluorometry in biochemistry; standard reference materials in fluorometry.

Fluorescence spectroscopy is an important tool of the biochemist studying the structure and interactions of proteins and nucleic acids. The four basic quantities to measure accurately are: 1. spectra (corrected excitation and emission), 2. quantum yields ($Q$), 3. fluorescence decay characteristics, and 4. polarization. Commercially available instruments, with little modification, can be used to obtain these measurements, but the biochemist in this field is very dependent on the accuracy of measurements of substances he uses as standards. Confusion arises from disagreement between reported values for standards which may be used to calibrate a detector system to obtain quantum yields, or to set up lifetime and polarization photometers. For instance, the protein chemist is fond of using tryptophan and quinine as quantum yield standards, but $Q$ for tryptophan has been variously reported as 0.13 and 0.20, and $Q$ values for quinine bisulfate range from 0.4 to 0.7. The biochemist should also be aware of the problems inherent in the use of commercially available instruments in absolute measurements, as well as the special complications arising in complex biochemical systems where the fluorescence is heterogeneous.

**Newer fluorometric methods for the analysis of biologically important compounds,** G. G. Guilbault, *SP378,* pp. 197-202 (May 1973).

Key words: Enzymes, fluorometric analysis; fluorometry of enzymes; fluorometry of substrates; silicone pad; solid surface fluorometry.

Newer fluorometric methods for the analysis of biologically important compounds will be discussed: enzymes such as LDH, alkaline phosphatase, lipase and cholinesterase, and substrates such as glucose, urea and uric acid. These

methods are based on the production of fluorescence initiated by an enzymic reaction.

New reagentless fluorescence methods will be described for enzymes and substrates. These methods are highly precise (1%), fast (less than 1 minute) and involve no preparation of reagents. These methods, as adapted to clinical laboratory procedures, will be discussed.

**Inorganic ions in glasses and polycrystalline pellets as fluorescence standard reference materials,** R. Reisfeld, *SP378,* pp. 203-225 (May 1973).

Key words: Fluorescence standards, inorganic ions; glass standards in fluorescence; rare-earth-doped glasses.

The absorption and fluorescence of inorganic ions; glass polycrystalline disks doped by heavy metal ions is discussed, and their use as fluorescence standards is evaluated. The advantages of the glass standards over other media is summarized.

The glass standards are divided into two groups (1) glasses doped by trivalent earths such as $Gd^{3+}$, $Tb^{3+}$, $Eu^{3+}$, $Sm^{3+}$, and $Tm^{3+}$ which have narrow band optical spectra as a result of intraconfigurational transitions, and (2) glasses and polycrystalline disks doped by ions such as $Tl^{+}$, $Pb^{2+}$, $Ce^{3+}$, and $Cu^{+}$ which have broad spectral bands since the optical spectra originate from interconfigurationally allowed transitions. Optical and physical parameters, including matrix effects, quantum efficiencies, decay characteristics, Stokes' shifts and spin-orbit versus orbit-lattice interactions due to the different transitions will be discussed.

Group (1) glasses are suitable for use as standards where a narrow well-defined fluorescence range is required, and group (2) glasses are suitable for use as standards whenever a substance with a wide range of fluorescence is measured. Special emphasis will be placed on energy transfer between donor and acceptor ions.

**Development of a new fluorescent reagent and its application to the automated assay of amino acids and peptides at the picomole level,** S. Udenfriend, *SP378,* pp. 227-230 (May 1973).

Key words: Fluorometry, amino acids; fluorometry, peptides; picomole fluorometry.

Methods for the assay of amino acids and peptides are most important in elucidating the structure of proteins and peptides. In many important areas of research such as in endocrinology, neurobiology, and genetics, methods are needed with sensitivity higher than is available with the widely used colorimetric ninhydrin procedure. A short while ago, we noted that all primary amines react with ninhydrin and phenylacetaldehyde to give a ternary product which is highly fluorescent. The chemistry of that reaction has now been elucidated and the conditions have been modified and improved so that essentially quantitative yields of fluorescent products are formed with all primary amines. The reaction has been automated and is being used as the detecting system for chromatography of amino acids, peptides and amines in the 10 to 100 picomole range. Problems concerning the fluorescence instrumentation and the isolation and chromatography of these compounds in the picomole range will be discussed.

**Considerations on organic compounds in solution and inorganic ions in glasses as fluorescent standard reference materials,** R. A. Velapoldi, *SP378,* pp. 231-244 (May 1973).

Key words: Emission spectra; excitation spectra; fluorescence; fluorescence standards; glass standards; quinine derivatives; rare earths; relative quantum efficiencies; solution standards.

The use of various organic compounds in solution and inorganic ions in glasses has been investigated as possible fluorescence Standard Reference Materials. Emphasis was placed on measuring physical and chemical parameters such as stability, reproducibilities of absorbance and fluorescence measurements, relative quantum efficiencies as a function of excitation wavelength, etc., for quinine derivatives and selected organic compounds. A brief discussion is included on the use of rare earth and non-rare earth inorganic ions in glasses as standards.

SP379. **Report of the 57th National Conference on Weights and Measures 1972,** F. C. Bell and H. F. Wollin, Report Editors, Nat. Bur. Stand. (U.S.), Spec. Publ. 379, 216 pages (May 1973) $1.85, SD Catalog No. C13.6/3:379.

Key words: Administration; Conference; laws; procedures; regulations; requirements; technology; weights and measures.

This is a report of the proceedings (edited) of the 57th National Conference on Weights and Measures, sponsored by the National Bureau of Standards, held in Washington, D.C., July 10-14, 1972, and attended by state, county, and city weights and measures officials, the Federal Government, business, industry, and consumer organizations.

SP380. **Photonuclear reaction data, 1973,** E. G. Fuller, H. M. Gerstenberg, H. Vander Molen, and T. C. Dunn, Nat. Bur. Stand. (U.S.), Spec. Publ. 380, 131 pages (Mar. 1973) $2.10, SD Catalog No. C13.10:380.

Key words: Bibliography; data index; data summary; elements; isotopes; nuclear physics; photonuclear giant resonance; photonuclear reaction.

A brief summary is given of the available data on the gross features of the photonuclear giant resonance. Data are presented in tabular form for all nuclei where measurements have been made. In addition, a comprehensive, annotated data index and bibliography are given which cover experimental data for the field of photonuclear reactions published in scientific and technical journals in the period from 1955 through 1972. Organized by element and isotope, each entry in the index is for a specific reaction reported in a given reference. Information is given on the type of measurement, excitation energies studied, source type and energies, detector type and angular ranges covered for each reaction entry. This publication supersedes NBS Miscellaneous Publication 277 and NBS Special Publication 322 which also embraced Supplement 1 to Misc. Publ. 277. All information contained in these publications has been combined and merged with new data to form the Photonuclear Data Index and Bibliography contained in this publication.

SP381. **Bibliography of ion-molecule reaction rate data (January 1950-October 1971),** G. A. Sinnott, Nat. Bur. Stand. (U.S.), Spec. Publ. 381, 73 pages (Oct. 1973) $1.00, SD Catalog No. C13.10:381.

Key words: Atoms; bibliography; cross-sections; ions; molecules; rate coefficients; reactions.

A bibliography is presented of papers in the open literature that contain original experimental data on ion-molecule reaction rates or cross sections. Positive and negative ion-molecule and ion-ion reactions are included but not electron impact processes. For papers to be included, the reactants must have been identified and data for kinetic energies below 10 electron volts must have been presented.

SP383. **The creative partnership: Government and the professional services,** Proceedings of the Fourth Users-Producers Conference Sponsored by the Technical Analysis Division, Institute for Applied Technology, National Bureau of Standards, in Cooperation with the Center for the Study of Private Enterprise, The American University, held at the National Bureau of Standards, Gaithersburg, Md., January 23, 1973, J. D. Johnson, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 383, 142 pages (Aug. 1973) $2.10, SD Catalog No. C13.10:383.

Key words: Creative-partnership; management; operating; procurement; services; Users-Producers.

These proceedings are written for the 4th Users-Producers Conference held at the National Bureau of Standards on January 23, 1973. The Conference was designed to highlight the problems and advantages in our present procurement system when Government utilizes the services of professional and Professions Service firms.

The speakers addressed themselves to the many facets of the procurement process. They represent both the private and Government side and bring their views forward in a clear and concise manner. Speakers are grouped into three panels. The first panel describes the development of the problem, the second panel considers the procurement process, and the third panel discusses managing the project. At the end of each group of panel speeches, there is a general discussion with comments and questions by all attendees.

There is also a separate presentation given by the Honorable James C. Corman, United States Congressman (Calif.), Chairman, Sub-Committee on Government Procurement of Professional Services. *These proceedings include the following papers (indented):*

**Management information and computer systems,** R. M. Davis, *SP383,* pp. 21-28 (Aug. 1973).

**Management consulting,** W. P. Sommers, *SP383,* pp. 29-41 (Aug. 1973).

**Architecture and engineering,** J. R. Dunn, *SP383,* pp. 42-45 (Aug. 1973).

**Operating level problems in procurement,** W. E. Cushen, *SP383,* pp. 46-56 (Aug. 1973).

**Government procurement policy,** P. Waterman, *SP383,* pp. 69-73 (Aug. 1973).

**The relationship of private enterprise to Government procurement,** R. W. Kreuger, *SP383,* pp. 74-78 (Aug. 1973).

**Legal aspects of Government procurement,** G. P. Bond, *SP383,* pp. 79-86 (Aug. 1973).

**A proposed Government system for professional services,** J. E. Moriarty, *SP383,* pp. 87-93 (Aug. 1973).

**Government project management,** T. F. Noble, *SP383,* pp. 107-109 (Aug. 1973).

**Managing the private contractor,** R. A. Walbrecker, *SP383,* pp. 110-114 (Aug. 1973).

**Managing the university research team,** R. P. Boynton, *SP383,* pp. 115-122 (Aug. 1973).

SP384. **Annotated bibliography of the literature on resource sharing computer networks,** R. P. Blanc, I. W. Cotton, T. N. Pyke, Jr., and S. W. Watkins, Nat. Bur. Stand. (U.S.), Spec. Publ. 384, 95 pages (Sept. 1973) $1.25, SD Catalog No. C13.10:384.

Key words: Bibliography; computer network; data communications; resource sharing.

This bibliography consists of references with critical annotations to the literature on computer networks. A classification scheme has been developed to place each annotation in a category reflective of its content. Five indexes to the bibliography are included: author index, corporate author index, network index, key word out of context index, and report number index.

SP385. **Transfer of radiation in spectral lines,** V. V. Ivanov, English language edition of *Radiative Transfer and the Spectra of Celestial Bodies.* Prepared in collaboration with D. G. Hummer from a draft translation by Eileen Weppner, Nat. Bur. Stand. (U.S.), Spec. Publ. 385, 480 pages (Nov. 1973) $7.45, SD Catalog No. C13.10:385.

Key words: Astrophysics; energy loss; photons; radiative transfer; spectral line profiles; stellar atmospheres.

This book is a revised and somewhat extended version of V. V. Ivanov's *Radiative Transfer and the Spectra of Celestial Bodies,* published in Moscow in 1969. The principal subject is the transfer of radiant energy through gas composed of atoms with two discrete levels. Although the emphasis of the book is on analytical methods, extensive numerical and graphical results are presented.

SP387. **Laser induced damage in optical materials: 1973.** Proceedings of a symposium sponsored by Office of Naval Research, The American Society for Testing and Materials and by the National Bureau of Standards, Boulder, Colo. May 15-16, 1973, A. J. Glass and A. H. Guenther, Editors, Nat. Bur. Stand. (U.S.), Spec. Publ. 387, 285 pages (Dec. 1973) $2.85, SD Catalog No. C13.10:387.

Key words: IR windows and mirrors; laser damage; laser materials; self-focusing; thin films.

The Fifth ASTM-ONR-NBS Symposium on Laser Induced Damage in Optical Materials was held at the National Bureau of Standards in Boulder, Colo. on May 15 and 16 of this year. These Symposia are held as part of the activities of Subcommittee II on Lasers and Laser Materials, of the ASTM. Subcommittee II is charged with the responsibilities of formulating standards and test procedures for laser materials, components, and devices. The chairman of Subcommittee II is Haynes Lee, of Owens-Illinois, Inc. Co-chairmen for the Damage Symposia are Dr. Arthur H. Guenther, Scientific Director, Technology Division of the Air Force Weapons Laboratory, and Dr. Alexander J. Glass, Head, Basic Studies, Y Division, Lawrence Livermore Laboratory.

Approximately 135 attendees at the Symposium heard 25 papers on topics relating to laser induced damage in crystalline and nonlinear optical materials, at dielectric surfaces, and in thin film coatings as well as discussions of damage problems in the infrared region due both to cw and pulsed irradiation. In addition, several reports on the theoretical analysis of laser-materials interaction, relative to the damage process were given, along with tabulations of fundamental materials properties of importance in evaluation of optical material response to high power laser radiation. Several papers presented by title only are included within the proceedings for completeness.

The proceedings of these Symposia represent the major sources of information in the field of laser induced damage in optical materials. The Symposia themselves, along with the periodic meetings of Subcommittee II, provide a unique forum for the exchange of information regarding laser materials specifications among the manufacturers and users of laser devices,

components, and systems. The Symposia also serve as a mechanism of information gathering to enable the Subcommittee to write informed and realistic specifications. *These proceedings include the following papers (indented):*

**The ARPA program on optical surface and coating science,** C. M. Stickley, *SP387*, pp. 3-10 (Dec. 1973).

**Nonlinear refractive index measurements in laser media,** A. Owyoung, *SP387*, pp. 11-24 (Dec. 1973).

Key words: Ellipse rotation; glass; nonlinear index; nonlinear susceptibility; self focusing; yttrium aluminum garnet.

The ellipse rotation technique has been employed to measure nonlinear refractive index changes in YAG and several laser glasses using a Q-switched $TEM_{00q}$ mode ruby oscillator-amplifier. By time resolving the 9 ns ellipse rotation signal, we obtain all of the information necessary to plot ellipse rotation vs. input power in a single shot, thereby also introducing the capability to detect transient contributions which would interfere with the measurement.

A small anisotropy is found in the third order nonlinear susceptibility of YAG and values for $n_2$ are inferred assuming electronic distortion to be the primary mechanism.

**Self-focusing in yttrium aluminum garnet and optical glasses,** A. Feldman, D. Horowitz, and R. M. Waxler, *SP387*, pp. 26–35 (Dec. 1973).

Key words: Absorption coefficient; electrostriction; Kerr effect; laser damage; nonlinear refractive index; optical glasses; self-focusing; thermal self-focusing; yttrium aluminum garnet.

An analysis of damage threshold data in borosilicate crown glass, fused silica, and dense flint glass for linearly and circularly polarized radiation indicates that the Kerr effect is the dominant self-focusing measurement for 1.06 $\mu$m laser pulses with a 25 ns temporal width. The calculated thermal effect is found to be larger than the electrostrictive effect, which is small. Self-focusing length measurements in yttrium aluminum garnet (YAG) are found to agree with theory. In YAG, the Kerr effect also dominates.

**A rational definition of index nonlinearity in self-focusing media,** A. J. Glass, *SP387*, pp. 36-41 (Dec. 1973).

Key words: Critical power; laser damage; nonlinear index; self focusing.

It is proposed that the index nonlinearity in self-focusing media be reported in terms of a critical power for the medium, $P_1$, rather than in terms of $n_2$. The principal results of self-focusing theory are expressed in terms of the ratio $(P/P_1)$, where P is the total power in a Gaussian beam. Using $P_1$ not only simplifies the expressions for quantities of physical interest, but also will remove some of the confusion now existing in the literature of self-focusing and laser damage.

**Self focusing of very powerful laser beams,** B. R. Suydam, *SP387*, pp. 42-48 (Dec. 1973).

Key words: Laser damage; nonlinear; self focusing.

Self focusing has heretofore been studied by assuming something equivalent to total collapse of the beam. Computer simulations at high power level show, however, that it is rather some small portion of the beam (e.g., a diffraction spike) which first collapses. We have therefore examined self focusing as a problem in stability theory. The method can be applied to divergent beams and to any medium in which gain is a known function of field strength. The theory agrees well with computer experiments. We find an absolute limit to the intensity available from a glass laser of order $10^{10}$ watts/cm$^2$.

**Homogeneity requirements for minimizing self-focusing damage,** J. Marburger, R. Jokipii, A. Glass, and J. Trenholme, *SP387*, pp. 49-56 (Dec. 1973).

Key words: Laser damage; nonlinear index; random index variation; self focusing.

The theory of wave propagation in random media is generalized in a straightforward way to include the effects of self focusing. Simple solutions are obtained which show how the intensity fluctuations which are induced by random inhomogeneities grow catastrophically. These solutions can be used to obtain conditions on the homogeneity of the medium, and on the fluctuations in the incident beam, for elimination or reduction of catastrophic self focusing in the medium.

**Self focusing and saturation in disk amplifiers,** K. A. Brueckner and J. E. Howard, *SP387*, pp. 57-62 (Dec. 1973).

Key words: Damage threshold; disk amplifiers; eikonal; saturation; self-focusing.

The methods of geometrical optics are used to investigate self focusing in arbitrarily spaced Nd glass disk amplifiers. Difference equations describing the growth of a localized ring or spot beam inhomogeneity are derived and solved numerically. The corresponding differential equations are solved in closed fo .n for the case of equally spaced disks, yielding explicit constraints on the allowable amplitude and width of spikes in terms of the thickness and spacing of the disks. In a more refined calculation, the decrease in gain at large flux densities is taken into account. The analytic and numerical results are applied to a typical laser system, wherein a chain of slab amplifiers is used to produce a high energy pulse for CTR experiments.

**Damage control in a 100 GW high power laser system,** J. Tillotson, B. Guscott, and K. Moncur, *SP387*, p. 63 (Dec. 1973).

Key words: Disc laser; laser damage; laser fusion; Nd-glass lasers.

With the development of high power $Nd^{+++}$ lasers for CTR research, severe damage in laser glass and optical components can be expected from both the output energy and from reflected plasma energy. At KMS, laser operating procedures, system diagnostics, and several isolation devices have been developed in an effort to reduce damage effects and to maximize laser lifetime. Since December 1972, the KMS laser system has operated in the 50-100 GW power range (up to 300 J at 3 nsec pulse width) for a total of 310 shots on target. An additional 2,379 laser shots have been fired for purposes of laser beam diagnostics. Plasma experiments with f/1 and f/1.5 focusing lenses have been performed with plane targets of $CD_2$, $CH_2$ and aluminum. This paper will discuss the KMS laser system, with particular emphasis on damage control procedures and equipment necessary for conducting high energy plasma experiments.

**Low scatter finishing of optical elements,** W. P. Barnes, *SP387*, pp. 64-68 (Dec. 1973).

Key words: Low scatter; mirror; optical surfacing.

The adaptation of bowl-feed polishing techniques to the low-scatter finishing of large optical elements is described. Electron micrographs of the surface of a 27 inch diameter fused silica spherical mirror indicate promise for the successful superpolishing of large, high-precision, optical elements.

**Laser surface damage studies on several glasses,** N. L. Boling, G. Dubé, M. D. Crisp, *SP387,* pp. 69-79 (Dec. 1973).

Key words: Absorption; electron avalanche; laser damage; plasma formation; polishing compound.

Q-switched laser induced surface damage studies on several glasses and sapphire are reported. By measuring thresholds on these various glasses, investigating the effect of various polishing compounds on damage of laser glass, studying damage morphologies, and taking care to detect damage in its initial stages, several conclusions are reached. Initial damage in practical situations is probably due to absorption by isolated submicron inclusions, and not electron avalanche. Inclusion type damage is found to occur without formation of the bright plasma associated with electron avalanche. The damage threshold is found to depend strongly on polishing compound in some cases. It is found that increased smoothness of a surface does not necessarily lead to an increased threshold.

**Some aspects of surface damage that can be explained with linear optics,** M. D. Crisp, *SP387,* pp. 80-83 (Dec. 1973).

Key words: Laser damage; surface damage.

Quantitative predictions of the relative values of surface damage thresholds for various geometries are found to follow from linear optics and simple assumptions concerning the damage mechanism. It is assumed that, for a fixed pulse shape, a surface will damage when it experiences an oscillating field of amplitude greater than a threshold value. This assumption is consistent with both absorption by inclusions and avalanche breakdown as a damage mechanism. The ratios of damage thresholds for entrance and exit surfaces at normal incidence, surfaces at Brewsters angle and a total internal reflection surface are found to depend only on the index of refraction of the material. It follows from the analysis that the different threshold values obtained from measurements made with various geometries are simply related and contain information about only one intrinsic surface parameter.

**Damage in lithium iodate with and without second harmonic generation,** C. R. Giuliano and D. Y. Tseng, *SP387,* pp. 84-90 (Dec. 1973).

Key words: Bulk damage; lithium iodate; phase matching; second harmonic generation.

The purpose of this study has been to determine whether a significant difference exists between bulk damage thresholds under conditions of phase matching (PM) for second harmonic generation (SHG) compared with the condition where phase matching is absent. Bulk damage in lithium iodate was studied both at 1.06 $\mu$m and 0.694 $\mu$m using single mode Q-switched lasers. Under the conditions of the experiment no significant difference was observed in damage thresholds between PM and non-PM conditions for single shot damage at 0.694 $\mu$m and for both single pulse and 10 pps at 1.06 $\mu$m.

**Laser surface damage studies at Bendix,** P. Bräunlich, J. Carrico, B. Rosenblum, and A. Schmid, *SP387,* pp. 91-102 (Dec. 1973).

Key words: Exoelectron emission; laser surface damage.

A status report will be presented which describes the application of the exoelectron imaging technique as a nondestructive test method for laser surface damage. The mechanism of exoelectron emission from dielectrics will be discussed and an outline of a theory of laser induced exoelectron emission will be given. It will be shown that thermally or optically stimulated electron emission images represent a record of physical phenomena that are precursors of laser surface damage. Experimental techniques used to obtain exoelectron images after laser exposure of the sample will be described and recent results presented.

**Effects of laser flux on GaAs,** J. L. Smith, *SP387,* pp. 103-106 (Dec. 1973).

Key words: GaAs; laser-induced acoustical pulse; laser-induced damage; stimulated Brillouin scattering; threshold dependence on wavelength and doping.

Pulsed laser damage thresholds for surface damage of GaAs have previously been measured for 0.694 and 1.06 $\mu$m laser beams. Measurements have recently been made for a 10.6 $\mu$m laser beam. These wavelengths were obtained with ruby, $Nd^{3+}$-glass, and TEA $CO_2$ lasers with pulse halfwidths of 20 nsec, 60 nsec, and 100 nsec, respectively. The first two lasers utilized dye Q-switched cells. Later work with the $Nd^{3+}$-glass laser incorporated a Pockels cell for Q-switching. Surface damage thresholds ranged from about 8 MW $cm^{-2}$ for 0.694 $\mu$m radiation to 30 MW $cm^{-2}$ for 10.6 $\mu$m radiation, and except for 10.6 $\mu$m radiation did not depend significantly on whether the GaAs was p-type, n-type, or undoped. For 10.6 $\mu$m radiation, the p-type GaAs was damaged at one third the value for the n-type GaAs and mostly exhibited bulk cracking rather than surface damage. The damage threshold of GaAs shows some dependence on the 1.06 $\mu$m laser pulse time, becoming lower as the pulse duration increases. Highly localized damage sites occurring at 1.06 $\mu$m cannot be accounted for by laser beam inhomogeneities. A study of the effects of surface trash on this localization revealed that, although visible trash does play a role, it need not be present for surface pits of approximately 2 $\mu$ size to occur. An arrangement utilizing a Pockels-switched $Nd^{3+}$-glass laser and quartz transducer was devised to determine whether the leading acoustical pulse induced in undoped GaAs bulk by the laser beam was rarefaction or compression. Rarefaction could result if the material were strongly electrostrictive, and this would bring out the question of the possibility of stimulated Brillouin scattering which depends on the effect. On the other hand, compression would result, for example, from thermal expansion. The study confirmed that the main effect of the 1.06 $\mu$m laser beam is to produce a compression in the leading pulse. The compression pulse amplitude was found to be proportional to the laser power up to the damage threshold.

**Carrier effects observed in laser-induced damage in a silicon junction photodetector,** J. F. Giuliani, *SP387,* pp 107-113 (Dec. 1973).

Key words: Laser damage; silicon photodetector; surface damage; surface recombination lifetimes.

Damage induced by a pulsed 1.06 $\mu$m laser was studied in a n-p-n silicon photodiode on the basis of measured surface changes using a technique of He-Ne beam probing of the photoconductive gain and excess minority carrier diffusion lengths as functions of increasing cumulative pulsed-laser energy.

These preliminary studies suggest that the pulsed laser produces significant changes in the surface recombination rates for the charge carriers and this in turn can be related to the measured changes in detector gain and dark current also as functions of increasing laser energy.

**The role of coating defects in laser-induced damage to thin**

**films,** L. G. DeShazer, B. E. Newnam, and K. M. Leung, *SP387,* pp. 114-123 (Dec. 1973).

Key words: Coating defects; damage morphology; damage thresholds; laser-induced scatter; mean distance between defects; rutile crystal damage; thin-film damage.

Laser damage to dielectric thin-film coatings was investigated using a $TEM_{00}$ Q-switched ruby laser. The laser-induced damage thresholds of several thin-film coatings increased with decreasing laser beam spot-size and were invariant for spot-sizes greater than 150 $\mu$m. A simple model has been suggested that the distribution and nature of coating defects have played an important role in this spot-size dependence, e.g., the probability of the laser beam striking a defect site will be greater for larger spot-sizes and that damage in materials can be distinguished as defect damage and intrinsic damage. This model can be also applied to surface damage.

**The role of inclusions and linear absorption in laser damage to dielectric mirrors,** D. Milam, R. A. Bradbury, and M. Bass, *SP387,* pp. 124-132 (Dec. 1973).

Key words: Dielectric mirror; inclusions; laser-induced damage; linear absorption.

By studying the morphology of threshold damage and observing the predicted "pulse duration-inclusion size" relationship we have found that laser damage to dielectric coatings is primarily determined by the presence of metallic or highly absorbing nonmetallic inclusions. It is also shown that linear absorption does not determine the damage resistance of coatings when they are properly prepared from materials which do not show bulk absorption.

**Time resolution of laser-induced damage to thin films,** N. Alyassini, J. H. Parks, and L. G. DeShazer, *SP387,* pp. 133-137 (Dec. 1973).

Key words: Laser induced film damage; optical probe; surface plasma; time resolved laser damage.

The time evolution of laser-induced damage to ZnS films was measured by monitoring the intensity of a He-Ne probe beam internally reflected from the films at the critical angle. The time behavior of the damage was measured with a resolution of 2 nsec, and was correlated to the ruby laser pulse and the spark emission, when present. This technique was used to compare the damage time evolution with the related damage site morphology observed in SEM photographs.

**Investigation of pulsed CO laser damage in coated metal mirrors and dielectric-coated windows,** S. Holmes and P. Kraatz, *SP387,* pp. 138-150 (Dec. 1973).

Key words: $CaF_2$ windows; CO laser damage; damage threshold; dielectric antireflection coatings; metal coatings; metal mirrors; protective overcoatings.

Results of some pulsed high power CO laser damage tests of metal-coated metal mirrors and AR-coated $CaF_2$ windows are reported. The laser employed in these tests is an E-beam pumped, CO gas laser which produces a multimode output pulse of ~ 100 $\mu$sec duration at a wavelength of 5 $\mu$m. It was focused to a spot size of ~ 2-3mm, yielding maximum energy densities in excess of 700J/cm$^2$. The mirrors tested were polished beryllium copper substrates coated with either silver or gold; the windows were polished $CaF_2$ having multilayer AR-coatings comprising combinations of $ThF_4$, $PbF_2$, $MgF_2$, and MgO. Damage threshold measurements and effects of fabrication parameters on performance are discussed.

**Pulsed $CO_2$ laser damage studies of windows and window coatings,** A. I. Braunstein, V. Wang, M. Braunstein, J. E. Rudisill, and J. Wada, *SP387,* pp 151-156 (Dec. 1973).

Key words: $CO_2$ laser damage; damage thresholds; laser windows; window coatings; KCl; ZnSe; CdTe.

A study was made of damage thresholds and damage morphology for KCl, ZnSe, and CdTe windows subjected to a pulsed $CO_2$ TEA laser. Damage to KCl and CdTe was initiated at the surfaces while ZnSe windows were found to fail due to explosion of inclusions in the bulk. For $As_2S_3$ passivated KCl or $ThF_4/As_2S_3$ antireflection coated KCl, or $BaF_2/ZnS$ antireflection coated ZnSe the damage morphology was the same as for uncoated windows—failure was not initiated by the coatings. For the two antireflection coating designs studied electric field distributions are shown, and their use in choosing between alternate designs is explained.

**Pulsed $CO_2$ laser damage studies of metal and dielectric coated mirrors,** V. Wang, A. Braunstein, M. Braunstein, J. E. Rudisill, J. Y. Wada, *SP387,* pp. 157-169 (Dec. 1973).

Key words: $As_2S_3$; CdTe; dielectric reflector; inclusions in dielectrics; KCl; pulsed $CO_2$ laser damage; thin film damage; ZnTe.

Damage thresholds measured using single transverse mode 10.6 $\mu$m radiation are reported for several metal and dielectric enhanced multilayer mirrors ($CdTe/ThF_4$, ZnTe/ZnS, $As_2S_3$/KCl). Typical values are in the range of several J/cm$^2$ for semiconductor thin films to over 30 J/cm$^2$ for wide bandgap dielectric thin films (pulse length 0.6 $\mu$sec). These single mode values are considerably lower than the corresponding multimode results. Scanning electron microscope, x-ray microprobe, and power dependent absorption measurements were performed in order to examine the nature of mirror surfaces before and after laser damage. Several models for potential damage mechanism (thermal, inclusion, dielectric, etc.) have been investigated. A comparison of the experimental and theoretical results has provided the basis for a possible damage model.

**Damage threshold in 10.6 $\mu$m laser materials,** J. Davit, *SP387,* pp. 170-174 (Dec. 1973).

Key words: Alkali halides; infrared windows; laser damage; TEA laser.

Q-switched laser damage thresholds have been determined for three materials: germanium (Ge), potassium chloride (KCl), and sodium chloride (NaCl). A $TEM_{00}$ mode $CO_2$ laser with output at 10.6 $\mu$m wavelength and a 75 nsec pulse length was employed. For the three materials, the damage observed was surface damage. In the case of potassium chloride and sodium chloride, while the surface damage threshold was about the same as with germanium, the surface breakdown threshold was much lower. Results on antireflection coated materials are also reported.

**Radiation induced damage to NaCl by 10.6 $\mu$m fractional joule, nanosecond pulses,** W. H. Reichelt and E. E. Stark, Jr., *SP387,* pp. 175-180 (Dec. 1973).

Key words: Damage threshold; exit damage; NaCl; surface damage.

Fractional joule nanosecond pulses from the Los Alamos pulsed $CO_2$ laser system have been used to obtain preliminary breakdown data for optical quality NaCl. Both surface and bulk damage have been observed. Surface damage in some samples takes the form of a rectangular craze pattern. This pattern is at the surface and similar to that observed by Bastow, et al., in TiC irradiated with light pulses from a Q-



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switched ruby laser. Estimated thresholds for breakdown and damage patterns are given.

**A study of 10.6 $\mu$m laser induced damage in alkali halide crystals,** H. Posen, J. Bruce, J. Comer, A. Armington, *SP387,* pp. 181-188 (Dec. 1973).

Key words: Alkali halides; ALQLOY; damage threshold; IR coatings; IR materials; laser damage.

Laser induced damage at 10.6 micrometers is observed in alloy alkali halide single crystals of the ALQLOY composition ($KCl_{0.33} - KBr_{0.67}$) and pure KCl, as a function of crystalline orientation. The effect of the stepwise increase in laser irradiation power is monitored by x-ray topographic techniques, Nomarski microscopy and electron microscopy of the replicated damage surface.

The relationship of the damage threshold to the crystalline orientation is explained by invoking the critical resolved shear stress law for the rock salt crystal structure of the alkali halides.

**Surface and coating absorption measurement with an Alphaphone,** E. L. Kerr, *SP387,* pp. 189-193 (Dec. 1973).

Key words: Absorption; coatings; high-power laser; measurements; surface; testing.

Optical elements and coatings for high power laser applications require low surface absorption. The Alphaphone provides an instrument for rapidly measuring surface absorption at laser wavelengths. Sensitivity is $10^{-5}$ absorption with 10 W input and a noise bandwith of 15 Hz. The total measuring time is a few minutes. Sensitivity down to $1.5\times 10^{-7}$ is achievable by decreasing the chopping frequency. In addition, sensitivity may be improved by signal averaging or by increasing the input power. Two surfaces of a window may be measured independently. Scattering has no significant effect.

The sample to be tested forms one wall of a thin cell filled with air. The air is heated by a small fraction of the energy absorbed at the sample surface when it is illuminated by the laser beam. The resulting pressure rise is measured by a capacitance microphone. In a demonstration we have recorded the absorption signals from two KRS-5 windows coated with antireflection coatings for 10.6 $\mu$m. The absorption was 1 percent, measured with a signal-to-noise ratio of 1000.

**Photoelastic constants of infrared transmitting materials,** B. Bendow and P. D. Gianino, *SP387,* pp. 194-201 (Dec. 1973).

Key words: IR transmitting materials; photoelasticity; stress-optics.

Stress-induced birefringence may severely degrade or limit the optical performance of IR transmitting materials, especially in high power laser applications. The birefringence in a given material is predictable once the photoelastic tensor has been determined. In this work we carry out a first-principles calculation of the photoelastic constants $p_{ij}$, employing a recent theory of Humphreys and Maradudin. For ionic crystals, a Born-Mayer interatomic potential is employed, while for semiconductors a Morse potential is employed. The $p_{ij}$ are calculated for a wide variety of rocksalt- and zinc blende-type crystals, including alkali-halides, II-VI's and III-V's. The electronic contribution to the $p_{ij}$'s is found to dominate in most semiconducting crystals, so that dispersion in the transparent frequency regime is generally negligible. For ionic materials, however, dispersion can be important; values at 10.6 $\mu$m, for example, may differ from those in the visible by as much as 25 to 50 percent, even for the better potential laser window materials.

**Checks of multiphonon absorption theory,** R. Hellwarth, *SP387,* pp. 202-207 (Dec. 1973).

Key words: Crystal absorption theory; frequency moments; infrared absorption; infrared susceptibility; infrared window materials; multiphonon absorption.

There is considerable uncertainty as to the accuracy of calcuations to date of multiphonon absorption in infrared window materials. Here we show that such uncertainties can be checked by calculating various weighted integrals over frequency ("frequency moments") of the imaginary part $\chi''(\omega)$ of the electrical susceptibility, to which the absorption coefficient $\beta(\omega)$ $cm^{-1}$ is related. We obtain expressions for six moments, evaluating a moment of the 2-phonon contribution explicitly for an anharmonic pair-interaction model. This exact result reveals inaccuracies in the dependence of absorption on ion masses and temperature predicted by approximate theories.

**Theory of material failure in crystals containing infrared absorbing inclusions,** C. J. Duthler and M. Sparks, *SP387,* pp. 208-216 (Dec. 1973).

Key words: Dielectric particles; inclusions; laser damage; thermal damage.

Small amounts of macroscopic inclusions in or on the surface of infrared-transmitting materials (in some cases a fractional volume of $10^{-7}$ to $10^{-8}$) increase the average value of the optical absorption coefficient $\beta$ and cause localized heating that could lead to material failure at high-power levels. The frequency dependence of $\beta$ ranges from increasing as $\omega^2$, to independent of $\omega$, to exponentially decreasing with $\omega$. Temperature dependence ranges from independent of T, to increasing as $T^p$ in the high-temperature limit, where $p \cong 1 - 4$ typically. Simple expressions for the absorption cross section are used to derive expressions for $\beta$ for large inclusions of strong and weak absorbers and small inclusions of dielectric and metallic particles. Material failure resulting from local heating of inclusions is a far greater problem in high-intensity short-pulse systems than in low-intensity long-pulse or cw systems having the same average intensity. Microsecond pulses with energy densities as low as a few joules per square centimeter can cause material failure.

**Surface damage by laser induced collective electron oscillations,** R. A. Shatas, L. M. Narducci, J. L. Smith, H. C. Meyer, and S. S. Mitra, *SP387,* pp. 217-224 (Dec. 1973).

Key words: Electron avalanche; electron tunneling in alternating fields; laser damage of GaAs; laser damage processes; laser-induced surface damage; parametric plasma instability; resonant plasmon-photon interaction; solid state plasma.

Recent experiments with high pressure infrared molecular lasers demonstrate that the surface damage of ancillary optical components is the performance limiting factor. Intensities of a few tens of MW $cm^{-2}$ in the pulse regime of fractional $\mu$sec are sufficient to damage the optical components; this performance is considerably less than what one would expect from the analysis of the intrinsic dielectric strength. It is proposed that the principal damage mechanism is associated with the damping of collective electron oscillations which have been driven beyond the linear regime by resonant photon-plasmon interaction. If the mobility of the carriers in a typical optical component is sufficiently high (such as for example in GaAs), one can adequately model the collective behavior of the carriers by a collisionless plasma. Thus the threshold for instabilities can be calculated on the basis of the Vlasov equation. In particular, the threshold for

parametric instabilities in GaAs illuminated by 10.6 $\mu$m radiation is shown to be of the order of $10^5$ V cm$^{-1}$ which is in close agreement with recent experimental results. The mechanism responsible for producing the critical electron density is proposed to be field-assisted electron tunneling. The required tunneling probability for electric fields of the order of the instability threshold is attained if the energy separation of bound to free state is less than the crystalline bandgap. Adsorbed impurities and bending of the crystal bands at the surface account for the lowered value of the effective pseudo gap; hence the damage is seen first at the surface of the material.

**Studies of intrinsic optical breakdown,** D. W. Fradin and M. Bass, *SP387,* pp. 225-238 (Dec. 1973).

Key words: Alkali halides; avalanche breakdown; intrinsic breakdown.

Previous work demonstrated that intrinsic optical damage is caused by electron avalanche breakdown. We have conducted a number of recent studies of intrinsic damage which have reinforced the original identification of the damage process and which have probed various characteristics of avalanche breakdown.

By using a ruby laser to induce damage in the alkali halides, we have observed frequency dispersion in the relative breakdown fields. This dispersion, which was not apparent at 1.06 $\mu$m, provides insight into the development of the avalanche. A mode-locked Nd:YAG laser with output pulses of 300 to 15 ps duration was used to induce damage in NaCl, and the results were compared to Q-switched studies. It was found that the rms breakdown field increased by almost an order of magnitude to over $10^7$ volts/cm as the pulse duration was reduced from 10 ns to 15 ps. This result agrees at least qualitatively with published dc breakdown measurements. A statistical character to bulk optical damage was observed in a number of materials including sapphire and fused quartz and found to be indistinguishable from statistics observed in surface damage. This observation and measurements of the ratio of surface to bulk breakdown fields show that the intrinsic mechanisms for surface and bulk breakdown are identical. Finally, the effect of crystalline disorder on the breakdown strength of solids was studied by measuring the intrinsic damage fields for a polycrystal, an alloy, and an amorphous insulator and comparing the results to the damage fields for the respective single crystals.

**Laser-induced surface damage in proustite ($Ag_3AsS_3$) at 1.06 $\mu$m and 0.694 $\mu$m,** G. R. Giuliano and D. Y. Tseng, *SP387,* pp. 239-249 (Dec. 1973).

Key words: $Ag_3AsS_3$; proustite; pulse duration dependence; repetition rate dependence; surface damage; 1.06 $\mu$m; 0.694 $\mu$m.

The results of a number of experiments on laser-induced entrance surface damage in proustite ($Ag_3AsS_3$) are presented. Morphology for pulsed and cw surface damage is discussed and illustrated. Damage at 1.06 $\mu$m where most of the work was done was studied with single pulse, repetitively pulsed, and continuous radiation; damage at 0.694 $\mu$m was studied with single pulses. It was found that the surface damage threshold at 1.06 $\mu$m is independent of pulse repetition rate from single pulse to 500 pps. Results of measurements taken for pulses of different duration are interpreted in terms of a thermal mechanism.

**Spectral emittance measurements on several crystalline samples,** D. L. Stierwalt, *SP387,* pp. 250-253 (Dec. 1973).

Key words: Absorption coefficient; emittance spectra; KBr; CdTe; ZnSe; $ZnSe_xTe_{1-x}$.

Emittance spectra were obtained at 273 and 373 K from 3 to 15 microns on several samples supplied by AFCRL. The specimens included KBr, CdTe, $ZnSe_xTe_{1-x}$, ZnSe, and four samples of Pb-doped KCl. Values of absorption coefficient were derived from the emittance data. Curves of absorption coefficient versus wavelength will be presented.

**A sensitive interferometric null method for measuring stress-induced birefringence,** G. Birnbaum and E. Cory, *SP387,* pp. 254-258 (Dec. 1973).

Key words: Birefringence; fused silica; optical spectrum analyzer; photoelastic effect; sapphire; scanning Fabry-Perot interferometer; YAG.

A sensitive apparatus for measuring induced birefringence utilizing a scanning Fabry-Perot interferometer excited by circularly polarized laser radiation has been developed. Because of birefringence in the sample located within the interferometer, its resonance wavelengths for radiation polarized parallel and perpendicular to the direction of applied stress are different. The voltage on a Kerr cell properly oriented within the interferometer is adjusted to cancel the sample birefringence. The wavelength difference is observed by using the scanning interferometer as a spectrum analyzer and comparing the resonance curves associated with each polarization. The stress-induced birefringence in YAG, sapphire and fused silica at 0.633 $\mu$ in the temperature range 26 to 75 °C has been measured.

SP389. **Some references on metric information with charts on all you need to know about metric and metric conversion factors,** W. R. Tilley, Editor, Nat. Bur. Stand. (U.S.), Spec. Publ. 389, 8 pages (Dec. 1973) 25 cents, SD Catalog No. C13.10:389.

Key words: Metric charts; metric information sources; metric publications.

A bibliography of metric publications issued by NBS along with a list of organizations that market metric publications, lists, and films for educators. Also includes two metric charts "All you need to know about metric" and "Metric conversion factors."

## 3.7. APPLIED MATHEMATICS SERIES

Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

AMS63. **Tables of two-associate-class partially balanced designs,** W. H. Clatworthy, J. M. Cameron, and J. A. Speckman, Nat. Bur. Stand. (U.S.), Appl. Math. Ser. 63, 327 pages (May 1973) $3.45, SD Catalog No. C13.32:63.

Key words: Analysis of PBIB designs; experiment designs; finite fields; finite geometries; finite projective planes; incidence matrices; incomplete block designs, partially balanced; mathematics; partially balanced incomplete block designs; PBIB designs; statistics; tables of PBIB designs.

This book is a revised and vastly expanded version of the monograph of R. C. Bose, W. H. Clatworthy, and S. S. Shrikhande, *Tables of Partially Balanced Designs with Two Associate Classes*, Tech. Bull. No. 107 of the North Carolina Agricultural Experiment Station, Raleigh, N.C., 1954.

Approximately 950 combinatorially distinct designs are given, which represents a doubling of the number of parametric specifications for designs of the original publication. The introduction includes special instructions to aid analysis using hand calculations and a section on the general least squares approach for use when the analysis is to be done on an electronic computer.

For those interested in the construction of the designs, information is provided on methods of construction and extensive references, including original sources for the designs, are given. A tabulation of known information about uniqueness, resolvability, and the nature of the corresponding dual and complementary designs is also included for each design.

## 3.8. NATIONAL STANDARD REFERENCE DATA SERIES

Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS. Program under the authority of National Standard Data Act (Public Law 90–396).

NSRDS-NBS43. **Selected specific rates of reactions of transients from water in aqueous solution. 1. Hydrated electron,** M. Anbar, M. Bambenek, and A. B. Ross, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 43, 67 pages (May 1973) 90 cents, SD Catalog No. C13.48:43.

Key words: Aqueous solution; chemical kinetics; data compilation; hydrated electron; radiation chemistry; rates.

Rates of reactions of hydrated electrons with over 700 different organic and inorganic molecules, ions, and transients have been tabulated. Most of the data are derived from pulse radiolysis of aqueous solutions; results from photolysis and from steady-state radiolysis by competition kinetics are also included.

NSRDS-NBS45. **Radiation chemistry of nitrous oxide gas. Primary processes, elementary reactions, and yields,** G. R. A. Johnson, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 45, 27 pages (Dec. 1973) 60 cents, SD Catalog No. C13.48:45.

Key words: Chemical kinetics; data compilation; dosimetry; G; gas; nitrous oxide; radiation chemistry; rates; review.

Data on the radiation yields from nitrous oxide gas, and the effects of variables, including dose-rate, total dose, pressure, temperature, applied fields and scavengers are reviewed and tabulated. The use of $N_2O$ as a gas-phase, chemical dosimeter is discussed. Primary processes in irradiated $N_2O$ are discussed and elementary reactions, relevant to the system, are listed.

NSRDS-NBS46. **Reactivity of the hydroxyl radical in aqueous solutions,** L. M. Dorfman, G. E. Adams, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 46, 72 pages (June 1973) 90 cents, SD Catalog No. C13.48:46.

Key words: Abstraction reactions; addition reactions; aqueous solution; biological molecules; electron transfer reactions; hydroxyl radical; oxide radical ion; radical reactions; rate constants; reference data.

The reaction rate data of the hydroxyl radical in aqueous solution are compiled and evaluated in this critical review. The values are reported in a series of tables covering additon, hydrogen abstraction, inorganic electron transfer and radical reactions. Rate constants for the hydroxyl radical with biological molecules are included. In addition, the rate constant data for the oxide radical ion are given. Physical properties are listed and the experimental methods employed in OH radical chemistry are reviewed. An analysis involving rate constant data comparisons is made.

NSRDS-NBS 50. **Resonances in electron impact on atoms and diatomic molecules,** G. J. Schulz, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 50, 118 pages (Oct. 1973) $1.35, SD Catalog No. C13.48:50.

Key words: Atoms; compound states; cross-sections; diatomic molecules; electron impact; energy levels; resonances; temporary negative ions.

Two reviews are presented on the energies, configuration and other properties of resonances in electron impact on atoms and diatomic molecules. Included are discussions of the experimental methods which are useful for studying resonances and of the results obtained by various investigations. Much of the information is presented in the form of tables and energy level diagrams.

## 3.9. BUILDING SCIENCE SERIES

Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

BSS44. **Full scale test on a two-story house subjected to lateral load,** F. Y. Yokel, G. Hsi, and N. F. Somes, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 44, 26 pages (Nov. 1972) 50 cents, SD Catalog No. C13.29/2:44.

Key words: Building damping; drift; dynamics; earthquake; frequency; housing; lateral resistance; racking; stiffness; structural deflections; vibration; wind load; wood frame construction.

Tests were carried out on a house to determine its deflection characteristics under lateral loads. The house is a two-story building of conventional wood-frame construction. Two series of tests were conducted. The first of these was to determine the stiffness of the house when subjected to a simulation of wind loading. The second was to determine the dynamic response of the house to a single impulse load.

The report presents the results of these tests from which the following primary conclusions were derived:

1. The measured second-story drift of the building under the test load was considerably less than the drift permitted for medium- and high-rise buildings by present design criteria for most areas of the United States.

2. Only a small portion of the distortion of the exterior walls was transmitted to the interior gypsum board.

3. The upper ceiling diaphragm experienced significant in-plane deformation. On the other hand, the floor/ceiling diaphragm at the lower ceiling level tended to act as a rigid diaphragm and to translate as a rigid body when the building was subjected to lateral load.

4. The natural frequency of the structure was approximately 9 Hz and damping averaged approximately 6 percent of critical damping varying from 4 to 9 percent.

BSS45. **Dynamic thermal performance of an experimental masonry building,** B. A. Peavy, F. J. Powell, and D. M. Burch, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 45, 103 pages (July 1973) $1.25, SD Catalog No. C13.29/2:45.

Key words: Building heat transfer; computer programs; dynamic thermal performance; heat flow analysis; heating and cooling loads; temperature predictions; thermal analysis; thermal behavior; transient heat flows.

Measurements of the dynamic heat transfer in an experimental masonry building were made in a large environmental chamber to explore the validity of a computer program developed at NBS, labeled NBSLD, for computing heating and cooling loads, and indoor air temperatures. This study was jointly supported by the National Bureau of Standards and the Department of Housing and Urban Development, and is a part of a broader research program being supported by both agencies to improve performance test procedures and criteria for housing.

The experimental structure was a one-room house 20 ft long 20 ft wide, and 10 ft high with walls of solid concrete blocks and a flat roof made of reinforced precast concrete slabs. During the tests changes were made in fenestration, the amount and location of insulation, and the indoor mass; and the building was exposed to a diurnal temperature cycle.

It was found that the combination of mass in the masonry walls and roof, and insulation placed on the outside of the masonry was very effective in reducing and controlling the variation of indoor air temperature. The NBSLD computer program realistically predicted the heat storage effects, and maximum heating loads during these tests. For five heating tests, the greatest difference between computed maximum heating load and measured values was 8 percent and the average difference was 4.3 percent. It was shown that steady-state methods of heating load calculation could result in oversizing heating equipment by 30 percent or more for this particular building and imposed exterior conditions if the lowest outdoor temperature was selected as the design temperature.

BSS46. **Building practices for disaster mitigation.** Proceedings of a workshop sponsored by The National Science Foundation, Research Applied to National Needs Program, and The National Bureau of Standards, held at the National Bureau of Standards, Boulder, Colo., Aug. 28-Sept. 1, 1972, R. Wright, S. Kramer, and C. Culver, Editors, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 46, 483 pages (Feb. 1973) $5.30, SD Catalog No. C13.29/2:46.

Key words: Building; earthquakes; hazards; land use; structural engineering; wind effects.

The national workshop on building practices for disaster mitigation was concerned with earthquakes, extreme winds, and similar dynamic hazards. These proceedings present recommendations derived at the workshop and addressed to policy makers in government and industry, as well as practitioners in engineering, architecture, land use planning, and the earth and meteorological sciences. The recommendations evaluate current building practices, define opportunities for improving current practice from documented research findings, and recommend research to fill gaps in knowledge. Recommendations are made for implementation of improved practices at professional and policy levels. The objectives include avoidance of human suffering, reduction of property loss, and maintenance of vital function in buildings under conditions threatening disaster. Fifteen review articles were prepared by experts in the professions and research disciplines to define the state-of-the-art in disaster mitigation and to guide discussions at the workshop. These articles are included in the proceedings as follows:

**Workshop recommendations,** *BSS46,* pp. 7–39 (Feb. 1973).

**Values and costs,** H. Kunreuther, *BSS46,* pp. 41-62 (Feb. 1973).

**Approaches to implementation,** P. E. Baseler, *BSS46,* pp. 63-81 (Feb. 1973).

**Earthquake hazards for buildings,** N. C. Donovan, *BSS46,* pp. 82-111 (Feb. 1973).

**The problem of seismic zoning,** S. T. Algermissen, *BSS46,* pp. 112-125 (Feb. 1973).

**Wind hazards for buildings,** J. W. Vellozzi and J. J. Healey, *BSS46,* pp. 126-138 (Feb. 1973).

**Land use planning and natural disaster mitigation,** W. J. Petak, M. McCoy, W. J. Monasch, J. E. Slosson, D. F. Moran, J. H. Wiggins, Jr., *BSS46,* pp. 139-178 (Feb. 1973).

**Architectural approaches to hazard mitigation,** E. C. Hillman Jr., A. E. Mann, *BSS46,* pp. 179-187 (Feb. 1973).

**Procedures and criteria for earthquake resistant design,** C. W. Pinkham, *BSS46,* pp. 188-208 (Feb. 1973).

**Procedures and criteria for earthquake resistant design,** N. M. Newmark and W. J. Hall, *BSS46,* pp. 209-236 (Feb. 1973).

**Procedures and criteria for wind resistant design,** J. W. Vellozzi and J. J. Healey, *BSS46,* pp. 237-252 (Feb. 1973).

**Criteria for building services and furnishings,** J. M. Ayres and T.-Y. Sun, *BSS46,* pp. 253-285 (Feb. 1973).

**Behavior of structural elements. A review,** B. Bresler, *BSS46,* pp. 286-351 (Feb. 1973).

**Behavior of structural systems under dynamic loads,** R. L. Sharpe, G. Kost, and J. Lord, *BSS46,* pp. 352-394 (Feb. 1973).

**Survey and evaluation of existing buildings,** F. E. McClure, *BSS46,* pp. 395-426 (Feb. 1973).

**Abnormal loading on buildings and progressive collapse,** N. F. Somes, *BSS46,* pp. 427-470 (Feb. 1973).

BSS47. **Structural deflections. A literature and state-of-the-art survey,** T. V. Galambos, P. L. Gould, M. K. Ravindra, H. Suryoutomo, and R. A. Crist, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 47, 104 pages (Oct. 1973) $1.25, SD Catalog No. C13.29/2:47.

Key words: Analysis; deflection; design; dynamic; experimental; human sensitivity; loading functions; specifications; static; structural engineering; subsystems; vibration.

A literature survey and state-of-the-art study was compiled using 233 primary source documents, research papers, and texts. Over 800 documents were scanned to arrive at the primary source documents. The problem of structural deflections is discussed and reviewed in its component areas of static and dynamic deflections as related to forcing functions and structural characteristics. Also the interactions of major structural deflections with building structures subsystems and human occupants is reviewed. Emphasis is placed on serviceability limit states of deflections. Detailed comparisons of human response to structural vibrations are also made. This report is broad in scope and covers the areas of analysis, design and experimentation.

## 3.10. FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATIONS

Publications in this series collectively constitute the Federal Information Processing Standards Register. The purpose of the Register is to serve as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973). FIPS PUBS will include approved Federal information processing standards information of general interest, and a complete index of relevant standards publications.

FIPS PUB 3-1. **Recorded magnetic tape for information interchange (800 CPI, NRZI),** P. S. Johnson, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process Stand. Publ. (FIPS PUB) 3-1, 4 pages (1973) 20 cents, SD Catalog No. C13.52:3-1.

Key words: Communications; computers; computer system hardware; data processing; data processing equipment; information systems; magnetic tape recording; magnetic tapes; magnetic tape transports; standards.

This standard specifies the recorded characteristics of 9-track, one-half inch wide magnetic computer tape, including the data format for implementing the Federal Standard Code for Information Interchange at the recording density of 800 characters per inch (CPI). It is one of a series of Federal Standards implementing the Federal Standard Code for Information Interchange (FIPS 1) on magnetic tape media. This revision to FIPS PUB 3 reflects a change in scope from the earlier version of X3.22-1967, and encompasses the recorded tape requirements only. The unrecorded tape standard will include the requirements for the physical properties of the tape and reels that were previously included in FIPS 3. Supersedes NBS FIPS PUB 3.

FIPS PUB 6-2. **Counties and county equivalents of the states of the United States. Federal general data standard representations and codes,** *(ANS X3.31-1973),* H. E. McEwen, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 6-2, 35 pages (1973) 65 cents, SD Catalog No. C13.52:6-2.

Key words: ADP standards; computers; data elements and codes; data processing; Federal Information Processing Standards; geography; information processing standards; information systems; national government; representation and codes; standards; statistical data.

This publication provides names and codes for representing the Counties of the 50 States or county equivalents thereof for use in the interchange of formatted machine sensible data. Also included in the set of codes are the independent cities of Maryland, Missouri, Nevada, and Virginia and the Census Divisions and boroughs of Alaska. Supersedes NBS FIPS PUB. 6-1.

FIPS PUB 8-3. **Standard metropolitan statistical areas,** H. E. McEwen, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 8-3, 20 pages (1973) 55 cents, SD Catalog No. C13.52:8-3.

Key words: Computers; data processing; Federal Information Processing Standards Publication; representations and codes; Standard Metropolitan Statistical Areas.

This publication provides standard identifications and codes for representing Standard Metropolitan Statistical Areas for the interchange of machine sensible data among agencies. It supersedes FIPS PUB 8-2, Standard Metropolitan Statistical Areas, dated 1972 November 1. The general concept of a Standard Metropolitan Statistical Area, commonly referred to as "SMSA" is one of an integrated economic and social unit with a recognized large population nucleus. The codes are available on Hollerith punched cards. The following data elements are provided: SMSA Title (Name) and SMSA Code. Supersedes FIPS PUB 8-2.

FIPS PUB 23. **Objectives and requirements of the Federal Information Processing Standards Program,** H. S. White, Jr., Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 23, 8 pages (1972) 35 cents, SD Catalog No. C13.52:23.

Key words: Computers; data processing; Federal Information Processing Standards; management; standards; U.S. Government.

Public Law 89-306 (the Brooks legislation) was enacted to provide for the economic and efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment by Federal departments and agencies. Among the other provisions of PL89-306, the Secretary of Commerce is authorized to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The Federal Information Processing Standards Program was established in response to this part of the legislation. The purpose of this document is to outline the objectives of the Federal Information Processing Standards Program and to identify requirements for specific standards necessary to accomplish these objectives.

FIPS PUB 24. **Flowchart symbols and their usage in information processing,** M. Keplinger, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 24, 4 pages (1973) 20 cents, SD Catalog No. C13.52:24.

Key words: Computer programming; computers; data processing, Federal Information Processing Standards; flow charting; flowchart symbols; information processing; standards.

This publication establishes standard flowchart symbols and specifies their use in the preparation of flowcharts in documenting information processing systems. This standard applies to any Federal information processing operation where symbolic representation is desirable to document the sequence of operations and the flow of data and paperwork.

FIPS PUB 25. **Recorded magnetic tape for information interchange (1600 CPI, phase encoded),** P. S. Johnson, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process Stand. Publ. (FIPS PUB) 25, 4 pages (1973) 20 cents, SD Catalog No. C13.52:25.

Key words: Communications; computers; computer systems hardware; data processing; data processing equipment; information systems; magnetic tape recording; magnetic tapes; magnetic tape transports; standards.

This standard specifies the recorded characteristics of 9-track, one-half inch wide magnetic computer tape, including the data format for implementing the Federal Standard Code for Information Interchange at the recording density of 1600 characters per

inch (CPI). It is one of a series of Federal Standards implementing the Federal Standard Code for Information Interchange (FIPS 1) on magnetic tape media.

FIPS PUB 26. **One-inch perforated paper tape for information interchange,** P. S. Johnson, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 26, 4 pages (1973) 20 cents, SD Catalog No. C13.52:26.

Key words: Data processing; Federal Information Processing Standard; information interchange; information processing; paper tape; paper perforator tape.

This standard specifies the physical dimensions and tolerances of one-inch wide paper tape, including the size and location of the perforations used for recording information.

FIPS PUB 27. **Take-up reels for one-inch perforated tape for information interchange,** P. S. Johnson, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process Stand. Publ. (FIPS PUB) 27, 4 pages (1973) 20 cents, SD Catalog No. C13.52:27.

Key words: Data processing; Federal Information Processing Standard; information interchange; information processing; paper tape; paper perforator tape.

This standard specifies the physical dimensions of paper tape take-up (or storage) reels, with either fixed or separate flanges. The two types of reels specified differ in the size and shape of the drive hub, but both are intended for use with one-inch perforated paper tape devices.

## 3.11. PRODUCT STANDARDS

Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The purpose of the standards is to establish nationally recognized requirements for products, and to provide all concerned interests with a basis for common understanding of the characteristics of the products. The National Bureau of Standards administers the Voluntary Product Standards program as a supplement to the activities of the private sector standardizing organizations.

PS54-72. **Body measurements for the sizing of girls' apparel,** C. W. Devereux, II, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 54-72, 19 pages (July 1973) 30 cents, SD Catalog No. C13.20/54-72.

Key words: Apparel, girls'; body measurements, girls'; classifications, girls' size; grading charts, girls' size; size designations, girls'; span charts, girls' sizing.

This Voluntary Product Standard establishes a nationally recognized sizing system for girls, based on body measurements. The standard covers three classifications: slims, regulars, and chubbies. In each classification, sizes 7, 8, 10, 12, 14, and 16 are defined by 33 body measurements.

PS56-73. **Structural glued laminated timber,** *(ANS A190. 1-1973),* K. G. Newell, Jr., Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 56-73, 12 pages (Oct. 1973) 45 cents, SD Catalog No. C13.20/2:56-73.

Key words: Glued laminated timber; laminated timber; structural glued laminated timber; timber, structural glued laminated.

This Voluntary Product Standard covers requirements for the dimensions, grade combinations, lumber for laminating, appearance grades, adhesive, and laminating of structural glued laminated timber as well as inspection and test procedures, marking, and the certification by a qualified inspection and testing agency. Definitions of the trade terms used are given, and guides for ordering and information on inspection practices are provided in the appendices.

# 3.12. TECHNICAL NOTES

Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other Government agencies.

TN270-7. **Selected values of chemical thermodynamic properties. Tables for the lanthanide (rare earth) elements (elements 62 through 76 in the standard order of arrangement),** R. H. Schumm, D. D. Wagman, S. Bailey, W. H. Evans, and V. B. Parker, Nat. Bur. Stand. (U.S.), Tech. Note 270-7, 93 pages (Apr. 1973) $1.25, SD Catalog No. C13.46:270-7.

Key words: Cerium compounds; dysprosium compounds; enthalpy; entropy; erbium compounds; europium compounds; gadolinium compounds; Gibbs energy of formation; holium compounds; lanthanides; lanthanum compounds; lutetium compounds; neodymium compounds; praseodymium compounds; promethium compounds; rare-earth elements; samarium compounds; terbium compounds; thulium compounds; ytterbium compounds.

Contains tables of values for the standard heats and Gibbs (free) energies of formation, entropies and enthalpies at 298.15 K and heats of formation at 0 K for compounds of the rare-earth elements (the lanthanides; lutetium through lanthanum; elements 62 through 76 in the Standard Order of Arrangement). These tables are a continuation of the comprehensive revision of NBS Circular 500.

TN361, Revised October 1972. **Liquid densities of oxygen, nitrogen, argon, and parahydrogen,** H. M. Roder, R. D. McCarty, and V. J. Johnson, Nat. Bur. Stand. (U.S.), Tech. Note 361 (Revised), 181 pages (Oct. 1972) $1.25, SD Catalog No. C13.46:361 (Revised).

Key words: Argon; compressed liquid; density; graphs; liquid; nitrogen; oxygen; parahydrogen; pressure; saturated liquid; tables; temperature; uncertainties; volume; volume correction factor.

Tables of pressure, volume, density and temperature for the saturated liquid and for compressed liquid states from the triple point to the critical point, of oxygen, nitrogen, argon, and parahydrogen are presented. The table entries of temperature are in Kelvin and Rankine, table entries in pressure are in atmospheres and psia. Volumes or densities are given in several different units, and density ratios or "volume correction factors" are tabulated for each entry. Estimates of the uncertainty for the tabulated data are given. The tables and graphs were prepared in the style and in the units preferred by users. They are intended as source for both technician and engineer. Revises and updates NBS Technical Note 361, issued January 31, 1968.

TN392. (Revised September 1973). **Thermodynamic properties of compressed gaseous and liquid fluorine,** R. Prydz and G. C. Straty, Nat. Bur. Stand. (U.S.), Tech. Note 392, 197 pages (Sept. 1974) $1.50, SD Catalog No. C13.46:392 (Rev. 1973).

Key words: Density; enthalpy; entropy; fixed points (PVT); fluorine; Joule-Thomson; latent heat; melting curve; PVT measurements; saturation densities; specific heats; vapor pressure; velocity of sound; virial coefficients.

An apparatus has been constructed and used successfully to measure vapor pressure and PVT data of fluorine from the triple point to 300 K at pressures to about 24 MN/m$^2$. Material problems caused by the toxic and corrosive nature of fluorine were solved. A network of isotherm and isochore polynomials and a truncated virial equation were used to represent all PVT data. These equations represent the data with an average standard deviation of about 0.02 percent in density, the corresponding accuracy being estimated at 0.1 percent. Equations for the saturated liquid and vapor densities, the vapor pressure curve, the melting line, and the ideal gas properties are also presented. Comparisons are given to published values of the second virial coefficients, vapor pressures, and saturation densities. Additional comparisons are also made to measured specific heats and latent heats of vaporization. New values are reported for the triple point and critical point parameters together with the temperature and saturation densities at the normal boiling point. Finally, extensive tables of thermodynamic properties of fluorine are given which include pressure, temperature, density, isotherm and isochore derivatives, internal energy, enthalpy, entropy, specific heats at constant pressure and volume and velocity of sound. Some erroneous values for the internal energy and enthalpy of the compressed liquid below 135 K, published previously, have been corrected in this revision.

TN583. **Electrochemical Analysis Section: Summary of activities, July 1970 to June 1971,** R. A. Durst, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 583, 113 pages (Feb. 1973) 75 cents, SD Catalog No. C13.46:583.

Key words: Acidity; coulometric analysis; electrochemical analysis; ionic activity; ion-selective electrodes; pH measurements; polarography; potentiometry; Standard Reference Materials.

This survey of the activities of the Electrochemical Analysis Section, Analytical Chemistry Division, covers the period from July 1970 to June 1971. An attempt is made to briefly summarize a year's progress on the technical projects of the Section, to indicate the composition and capabilities of the unit as a whole, and to stress the Section's role in the mission of the Institute. Summaries of the work in each of the Section competences are given. In the area of acidity measurements, work was completed on the standardization of tris(hydroxymethyl)aminomethane for use as a biologic pH buffer material and standard for clinical pH measurements. High-precision coulometry is used to determine the atomic weight of zinc, the stoichiometry of gallium arsenide, and the purity of KCl and NaCl. Polarography is used to determine trace elements in a variety of environmental samples and Standard Reference Materials.

TN594-4. **Optical radiation measurements: The impact of radiometry and photometry and the role of NBS,** B. Steiner, Nat. Bur. Stand. (U.S.), Tech. Note 594-4, 56 pages (Mar. 1973) 80 cents, SD Catalog No. C13.46:594-4.

Key words: Agriculture; clinical analysis; economic impact; energy crisis; meteorology; photometry; phototherapy; pollution; radiometry; remote sensing.

Serious measurement discrepancies universally plague quantitative measurement in the electro-optics industry. The impact of the resulting problems is reviewed and the role of NBS explored. The measurement discrepancies arise chiefly through the recent explosive expansion of this industry. The growth has precipitated a complex development in the variety and accuracy

of measurements required. The impact of problems in optical radiation measurement falls in many areas. One is the increasing Federal responsibility for public life defined in recent legislation. Another is the influence of good optical radiation measurement on the technical development of the electro-optics industry. The impact of these measurements on a number of public issues is reviewed: public health, public safety, the energy crisis, meteorology, pollution, agriculture, crime prevention, and surveillance from air and space. The economic impact of improved measurement both on a fair domestic market and on the balance of payments operates through unit production cost, quality control, product improvement, and innovation. Leadership by NBS has been urged by the industry not only in fulfillment of its legislative responsibility but also to permit the focus of elaborate and impartial resources on the complex problem of optical radiation measurement. In keeping with its mission to help improve industrial technology and the competitiveness of American industry, NBS has an opportunity of major proportions in the electro- optics industry..Leaders of this industry are calling for NBS initiatives to resolve many of the measurement problems now hindering further progress.

TN594-5. **Optical radiation measurements: Stability and temperature characteristics of some silicon and selenium photodetectors,** K. Mohan, A. R. Schaefer, and E. F. Zalewski, Nat. Bur. Stand. (U.S.), Tech. Note 594-5, 16 pages (June 1973) 35 cents, SD Catalog No. C13.46:594-5.

Key words: Fatigue; light memory; photoceils; photodiodes; photometry; radiometry; selenium; silicon; stability; temperature dependence.

This paper describes the comparison of some characteristics of selenium barrier layer photocells and silicon PIN and PN type photodiodes operated in the photovoltaic or nonbiased mode. The work was done to study the suitability of these detectors specifically for goniometric measurements of flux and possibly for other photometric (or radiometric) measurements. The characteristics studied were the stability of detector output over approximately twenty hours, fatigue or light memory effects over short periods of time, and the temperature dependence of detector output.

TN620. **Frequency and phase stabilization of an HCN laser by locking to a synthesized reference,** J. S. Wells and D. Halford, Nat. Bur. Stand. (U.S.), Tech. Note 620, 56 pages (May 1973) 60 cents, SD Catalog No. C13.46:620.

Key words: Fast linewidth; frequency noise; HCN laser; infrared frequency synthesis; laser frequency measurements; laser linewidth; laser stabilization; phase locked laser.

Infrared frequencies as high as 88 THz have recently been synthesized using diode harmonic mixers with accuracies of parts in $10^9$. Stabilized lasers are needed to make frequency measurements of higher accuracy. The HCN laser is the lowest frequency basis laser used in these synthesis schemes and its stabilization has been the subject of recent interest. The laser is stabilized by locking it to a phase locked microwave reference chain. Two servo loops are utilized. The first loop is a relatively slow frequency lock loop with the correction applied to a PZT driver. This loop not only accommodates thermal expansion of the laser, but also serves as an acquisition aiding loop for the second servo. The latter is a phase locked system with the correction applied to the laser discharge current.

Details of the laser design and some noise considerations relative to the microwave reference chain are presented along with some experimental data which indicate the results of the stabilization techniques. Data regarding the system stability and improved fast linewidth are included.

TN625. **Computer programs for thermodynamic and transport properties of hydrogen (Tabcode-II),** H. M. Roder, R. D. McCarty, and W. J. Hall, Nat. Bur. Stand. (U.S.), Tech. Note 625, 226 pages (Oct. 1972) $1.75, SD Catalog No. 13.46:625.

Key words: Computer programs; density; enthalpy; entropy; heat capacity at constant pressure; heat capacity at constant volume; heat capacity ratio; heat transfer coefficient; hydrogen; pressure; saturation boundary; temperature; thermal conductivity; velocity of sound; viscosity.

The thermodynamic and transport properties of para and equilibrium hydrogen have been programmed into a series of computer routines. Input variables are the pair's pressure- temperature and pressure-enthalpy. The programs cover the range from 1 to 5000 psia (34 MN/m²) with temperatures from the triple point to 6000 °R (3300 K) or enthalpies from − 130 Btu/lb (− 623 J/mol) to 25,000 Btu/lb (117000 J/mol). Output variables are enthalpy or temperature, density, entropy, thermal conductivity, viscosity, velocity of sound, heat capacity at constant pressure, heat capacity at constant volume, the heat capacity ratio, and a heat transfer parameter. Property values on the liquid and vapor boundaries are conveniently obtained through two small routines. The programs achieve high speed by using linear interpolation in a grid of precomputed points which define the surface of the property returned. The maximum errors arising from the linear interpolation are shown on individual deviation plots for each combination of variables. Error estimates for the sources of data are similarly displayed.

TN626. **The generation of an accurate and uniform time scale with calibrations and prediction,** K. Yoshimura, Nat. Bur. Stand. (U.S.), Tech. Note 626, 64 pages (Nov. 1972) 60 cents, SD Catalog No. C13.46:626.

Key words: Accurate and uniform time scale; Allan variance; dispersion of time scale; ensemble time (error); prediction interval; primary standard and clocks.

We express a predicted time interval (or frequency) of a single clock as a weighted sum of frequency data obtained by calibrations against a primary standard, and derive a matrix equation for the optium weighting coefficients (called the optimum filter response function) involving the Allan variances. Two approaches are used. One of the approaches turns out to be a generalization of Barnes' approach in his 1966 IEEE paper.

We solve the matrix equation to get the optimum filter response functions for white noise frequency modulation (FM), flicker noise FM and linear combinations of them. Other important time dispersive mechanisms exist in practice but are not considered here. We obtain the result that the mean square time prediction error would increase as elapsed time $t^2$ for the case without intermediate calibrations.

We obtain the result that with a small number of good clocks one can construct a time scale whose accuracy is limited by the accuracy of a primary standard. We show that, over a long time range, linear prediction algorithms based on frequency calibrations with a primary standard give a time scale of much better accuracy and stability than when intermittent calibrations are not used, and that (at least for statistically identical clocks), *no advantage is gained* by using the time scale itself as a "primary standard" for intermediate calibrations.

TN627. **Computation of spectral data for a Josephson junction circuit,** E. G. Johnson, Jr. and D. G. McDonald, Nat. Bur.

Stand. (U.S.), Tech. Note 627, 63 pages (Nov. 1972) 60 cents, SD Catalog No. C13.46:627.

Key words: Differential equation; fast Fourier transform; Josephson junction; nonlinear integral-differential equation; spline theory.

A computer program has been developed to study power flow between different frequency channels in a Josephson junction circuit. This paper discusses the mathematical assumptions used to get such results. They are the trapezoidal approximation from spline theory and the use of a finite range of frequencies to characterize the frequency spectrum. This paper describes the program and provides the FORTRAN listing, flow charts, and discusses how to use the program. A discussion of possible sources of errors is also included.

TN628. **On the utility of the m-6-8 potential function,** H. J. M. Hanley and M. Klein, Nat. Bur. Stand. (U.S.), Tech. Note 628, 77 pages (Nov. 1972) 70 cents, SD Catalog No. C13.46:628.

Key words: Dispersion coefficients; m-6-8 potential; parameter selection; second virial coefficients; transport properties.

The calculation of transport and equilibrium properties of simple gases with the m-6-8 potential function is discussed. Properties referred to specifically are the viscosity, diffusion, thermal conductivity and second virial coefficients, and the thermal diffusion factor. Gases referred to are argon, krypton, xenon, nitrogen, oxygen, carbon dioxide and methane. We also discuss in detail the general behavior of a model potential with respect to the fitting of data and the selection of potential parameters. The m- 6-8 appears to be the simplest model potential which can satisfactorily be used to fit data over a wide temperature range. The relationship of the potential to independent theory is briefly examined.

TN629. **Superconducting quantum interference devices: An operational guide for rf-biased systems,** D. B. Sullivan, Nat. Bur. Stand. (U.S.), Tech. Note 629, 47 pages (Nov. 1972) 50 cents, SD Catalog No. C13.46:629.

Key words: Electrical measurements; quantum interference devices; superconductivity.

The report discusses a number of practical considerations concerning the operation and application of rf-biased Superconducting QUantum Interference Devices (SQUID's). In the course of routine operation of these devices one amasses a set of operational rules, many of which never reach the open literature. This report is aimed at filling that void. Topics of discussion include: the readout circuitry, operational limits of the SQUID, rf-coupling to the SQUID, flux transformers, and shielding.

TN630. **Developments in cryoelectronics,** R. A. Kamper and D. B. Sullivan, Nat. Bur. Stand. (U.S.), Tech. Note 630, 73 pages (Nov. 1972) 70 cents, SD Catalog No. C13.46:630.

Key words: Electronics; Josephson effect; precise measurements; superconductivity.

This is a survey of progress to date in the development of new electronic instruments taking advantage of the unique properties of superconductors.

TN631. **Thermophysical properties of helium-4 from 2 to 1500 K with pressures to 1000 atmospheres,** R. D. McCarty, Nat. Bur. Stand. (U.S.), Tech. Note 631, 161 pages (Nov. 1972) $1.25, SD Catalog No. C13.46:631.

Key words: Density; dielectric constant; enthalpy; entropy; equation of state; fixed points; heat transfer coefficients; helium 4; index of refraction; Joule-Thomson coefficient; lambda line; latent heat; melting point; Prandtl number; specific heats; speed of sound; surface tension; thermal conductivity; thermal diffusivity; vapor pressure; viscosity; volume.

Tables of thermophysical properties of helium 4 are presented for temperatures from 2 to 1500 K for pressures to 1000 atmospheres. The tables include, entropy, enthalpy, internal energy, density, volume, speed of sound, specific heat, thermal conductivity, viscosity, thermal diffusivity, Prandtl number and the dielectric constant for 62 isobars. Also included in the isobaric tables are quantitites of special utility in heat transfer calculations: $(\partial P/\partial V)_T$, $(\partial P/\partial T)_\rho$, $V(\partial H/\partial V)_P$, $V(\partial P/\partial U)_V$, $-V(\partial P/\partial V)_T$, $1/V(\partial V/\partial T)_P$.

In addition to the isobaric tables, tables for the saturated vapor and liquid are given which include all of the above properties, plus the surface tension. Tables for the $P\rho T$ of the freezing liquid, $P\rho T$ of the lambda line, index of refraction and the derived Joule-Thomson inversion curve are also presented. A computer program to calculate the various properties is also available. Inquiries should be addressed to the National Bureau of Standards, Cryogenic Data Center, Boulder, Colorado 80302.

TN632. **Frequency stability specification and measurement: High frequency and microwave signals,** J. H. Shoaf, D. Halford, and A. S. Risley, Nat. Bur. Stand. (U.S.), Tech. Note 632, 70 pages (Jan. 1973) 65 cents, SD Catalog No. C13.46:632.

Key words: Allan variance; frequency stability measurements; measurement system description; phase noise, spectral density; stability definitions; terminology standards.

This report gives concise definitions for specifying stability for measurements in the frequency domain and time domain. Standards of terminology and of measurement techniques are recommended. Measurement systems in the high frequency and microwave regions are described in adequate detail so that the systems may be duplicated.

TN633. **Critical two-phase flow for cryogenic fluids,** R. V. Smith, K. R. Randall, and R. Epp, Nat. Bur. Stand. (U.S.), Tech. Note 633, 80 pages (Jan. 1973) 70 cents, SD Catalog No. C13.46:633.

Key words: Analyses; analytical models; choking flow; critical flow; cryogenic fluids; helium; hydrogen; oxygen; reviews; two-phase flow.

This work presents a state-of-the-art survey intended to be useful to a designer of equipment involving two-phase flow of cryogenic fluids. It is desirable to assess the probability of critical, or choking flow in such a system and, if possible, estimate the critical flow rate. The literature is surveyed, primarily since Smith (1963), and the predictive results for several analytical models are evaluated and compared with experimental data. These results are discussed; however, no firm conclusions are reached because, often, the spread of experimental data is equivalent to the predictive results from the models. Finally, computer evaluations are presented for oxygen, hydrogen and helium along with some design recommendations.

TN634. **Lorenz ratios of technically important metals and alloys,** J. G. Hust and L. L. Sparks, Nat. Bur. Stand. (U.S.), Tech. Note 634, 133 pages (Feb. 1973) $1.25, SD Catalog No. C13.46:634.

Key words: Alloys; compilation; cryogenic; electrical resistivity; Lorenz ratio; metals; thermal conductivity.

A comprehensive review and compilation of the world litera-

ture on Lorenz ratio of technically important metals and alloys is presented. Lorenz ratio, electrical resistivity, thermal conductivity and characterization data are compiled in tabular form and the Lorenz ratio data are presented in graphical form as well. Data are included here only if the research reported both thermal conductivity and electrical resistivity of the specimens. No attempt has been made to smooth data or present recommended values.

TN635. **Some applications of cryogenics to high speed ground transportation,** V. C. Arp, A. F. Clark, and T. M. Flynn, Nat. Bur. Stand. (U.S.), Tech. Note 635, 29 pages (Feb. 1973) 35 cents, SD Catalog No. C13.46:635.

Key words: Levitation; magnetic suspension; materials fatigue data; refrigeration; superconducting magnets; transportation.

The current status (December 1972) of worldwide research on high speed ground transportation techniques is reviewed. Particular attention is given to studies of magnetic levitation using superconducting magnets, including comparison with alternative magnetic techniques and with air suspension systems. Superconducting levitation appears to be a strong contender in the U.S. Department of Transportation hopes to select in the late 1970's the best of the possible levitation techniques for subsequent advanced development. Cryogenic engineering research needed in support of major development of a superconducting levitated system is identified.

TN636. **Modeling of atomic clock performance and detection of abnormal clock behavior,** W. A. Ganter, Nat. Bur. Stand. (U.S.), Tech. Note 636, 39 pages (Mar. 1973) 50 cents, SD Catalog No. C13.46:636.

Key words: Atomic clock model; detection; flicker noise; sequential test; time scale.

We have assumed that the nominal performance of an atomic clock can be well characterized by (1) a noise amplitude and (2) a mix of white and flicker pure noise processes. A number of specific kinds of changes are assumed that a clock might encounter. We assume that these changes can occur with either sign and with varying magnitudes. The changes considered are a noise amplitude different from nominal, a flicker component in the noise mix which is different from nominal, a step jump in the time counts for a clock and a linear (frequency jump) or quadratic (frequency drift) trend in the time counts for a clock.

Detection of a change is accomplished with a multiple sequential test having compound limits. The test is designed to respond quickly to an actual change but to make few incorrect detections (identify the wrong change) or false detections (when no change from nominal operation has occurred). When a change is detected for a clock, the laboratory time scale can be adjusted accordingly for this condition.

TN637. **Theory of UHF and microwave measurements using the power equation concept,** G. F. Engen, Nat. Bur. Stand. (U.S.), Tech. Note 637, 68 pages (Apr. 1973) 70 cents, SD Catalog No. C13.46:637.

Key words: Microwave; microwave measurements; power equation; power measurement; terminal invariant.

Theoretical considerations indicate that, in addition to other advantages, UHF and microwave measurements based on the power equation concept should exhibit reduced sensitivity to certain connector imperfections. This has now been experimentally confirmed in a number of laboratories, and interest in these methods is increasing. The previously described measurement techniques, for implementing this concept, have relied heavily upon tuning procedures, while current trends are towards automation where tuning is impractical if not impossible.

By assuming a phase detection capability (such as is found in automated systems) it is possible to eliminate the tuning requirement. Moreover, this generalization has made it possible to summarize the earlier results in a compact form. In addition, this paper includes a number of new measurement ideas.

It is expected that this report will serve as a major reference in the continuing development of detailed measurement procedures which exploit the power equation concept.

TN638. **A synchronous satellite time delay computer,** W. F. Hamilton and D. W. Hanson, Nat. Bur. Stand. (U.S.), Tech. Note 638, 39 pages (July 1973) 45 cents, SD Catalog No. C13.46:638.

Key words: Satellite timing; slant range; synchronous satellites; time delay.

A special purpose slide rule designed to compute the free space propagation delay between a synchronous satellite and points on the earth's surface is discussed. The slide rule was developed to provide users of time information relayed by geostationary satellites a means of computing the propagation delays without dealing directly with the satellite's orbital elements. The delays computed with the slide rule are compared with the values obtained from orbital elements using a high precision digitial computer. The limitations and accuracy of the slide rule are discussed. A sample slide rule which may be cut out and used is included in the report.

TN639. **Publications and services of the National Bureau of Standards, Cryogenics Division, Institute for Basic Standards, Boulder, Colo. 80302, 1953-1972,** J. R. Mendenhall, V. J. Johnson, and N. A. Olien, Nat. Bur. Stand. (U.S.), Tech. Note 639, 82 pages (Aug. 1973) 75 cents, SD Catalog No. C13.46:639.

Key words: Author indexes; bibliography; cryogenics; liquefaction; metrology; properties of fluids; properties of solids; subject indexes; superconductivity; transport processes.

This NBS Technical Note catalogs the publications of the Cryogenics Division, along with author and subject indexes, for the period 1953 through 1972. It also contains a listing of available thermodynamic properties charts, bibliographies, and miscellaneaous reports of cryogenic interest.

A resumé of the activities of and services provided by the Cryogenics Division is also included.

TN640. **Considerations for the precise measurement of amplifier noise,** D. F. Wait, Nat. Bur. Stand. (U.S.), Tech. Note 640, 129 pages (Aug. 1973) $1.25, SD Catalog No. C13.10.46:640.

Key words: Amplifier noise; effective input noise temperature; mismatch error; mismatch uncertainty; noise figure.

For the best accuracy in measuring noise figure, attention needs to be given to the choice of the hot and the cold noise standards and to mismatch problems. Tables and graphs are presented to aid in choosing the proper measurement conditions, and an example is given to demonstrate their use. This paper essentially supplements a previous paper (included in an appendix), treating in more detail topics that become important when state-of-the-art measurements are required.

TN641. **Survey of the properties of the hydrogen isotopes below their critical temperatures,** H. M. Roder, G. E. Childs, R. D. McCarty, and P. E. Angerhofer, Nat. Bur. Stand. (U.S.), Tech. Note 641, 122 pages (Oct. 1973) $1.25. SD Catalog No. C13.46:641.

Key words: Compilation; density; deuterium; electrical properties; enthalpy; entropy; fixed points; hydrogen; mechanical properties; optical properties; specific heat; thermophysical properties; transport properties; tritium; vapor pressure.

The survey covers PVT, thermodynamic, thermal, transport, electrical radiative and mechanical properties. All isotopic as well as ortho-para modifications of hydrogen have been included. Temperatures are limited to those below the respective critical points, in general below 40 K. The pressure range is not restricted, that is solid, liquid, and gas phases are covered. However, with the exception of hydrogen, very little data exists at pressures other than saturation. The literature surveyed includes all references available to the Cryogenic Data Center up to June of 1972, and for several subjects, through March of 1973. The total number of documents considered was nearly 1500 of which about 10 percent contain pertinent information and are referenced in this report. The various properties are presented in the form of tables of graphs; if extensive tables have been published elsewhere, the reader is referred to the original sources.

TN642. **Summary of WR15 flange evaluation at 60 GHz,** B. C. Yates and G. J. Counas, Nat. Bur. Stand. (U.S.), Tech. Note 642, 32 pages (Oct. 1973) 40 cents, SD Catalog No. C13.46: 642.

Key words: Attenuation; flange measurements; reflection coefficients; VSWR.

The measurement results of flange loss and reflection coefficient magnitude at 60 GHz (WR15 waveguide) of various flange configurations are presented. Included are the effects of alignment pins, surface finish, metallic contact surface, contact area, and flange bolt torque.

TN643. **Measurement of rf power and attenuation using superconducting quantum interference devices,** R. A. Kamper, M. B. Simmonds, C. A. Hoer, and R. T. Adair, Nat. Bur. Stand. (U.S.), Tech. Note 643, 93 pages (Aug. 1973) $1.00, SD Catalog No. C13.46:643.

Key words: Josephson effect; quantum interference; rf attenuation; rf measurement; rf power; superconductivity.

This report is the product of the first two years' work on a project to exploit an entirely new principle for the measurement of rf power and attenuation, namely the Superconducting QUantum Interference Device (SQUID). This is a simple circuit of superconducting metal, operating at a very low temperature in a bath of liquid helium. It functions as a sensor of magnetic flux with an almost perfectly periodic response over a wide dynamic range. It may therefore be used to measure dc or rf electrical quantitites such as current, power, attenuation, etc., in circuits inductively coupled to it. Measurements of these quantities can be made by counting off periods in the response of the SQUID (flux quanta) in the same way that we measure length with a laser by counting off wavelengths of light.

This work is partly funded by the CCG under project number 72-72. It has reached the stage of a demonstration that the new principle can indeed be used for precise measurement. We have developed and tested prototype systems for measuring power and attenuation as accurately as we can test by the conventional means available to us. A single calibration with dc is required to measure absolute rf power in the range of frequency from 0 to 1 GHz at levels from $10^{-8}$W to $10^{-3}$W with an uncertainty of $\pm 0.1$ dB at the port of the SQUID. Transferring this measurement to calibrate a source of power would require a proper evaluation of the intervening network over the full range of frequency. We have demonstrated the feasibility of extending our measurements of power to much lower levels. No external calibration is required to measure rf attenuation directly over a dynamic range of 45 dB with an rms deviation of $\pm 0.002$ dB from calibrations performed by the NBS Calibration Service.

After an elementary exposition of the basic principles of our technique, we describe: the SQUIDs themselves; the prototype systems we have developed to measure rf power and attenuation; systematic errors and fundamental limitations of the measurements that can be performed with them; and the obvious and immediate improvements that can be applied to them. We reserve an appendix for detailed drawings and instructions for the fabrication of components.

In order to make this report self-contained, we have included the material from previous reports that has successfully withstood the test of time.

TN644. **Application of a non-ideal sliding short to two-port loss measurement,** M. P. Weidman and G. F. Engen, Nat. Bur. Stand. (U.S.), Tech. Note 644, 40 pages (Oct. 1973) 50 cents, SD Catalog No. C13.46:644.

Key words: Efficiency; loss; reflectometer; sliding short; two-port.

A detailed, applications-oriented, description of a method for measuring two-port losses is given. The technique involved uses a non-ideal sliding short circuit and a tuned four-arm reflectometer. Most, if not all, of the components used in this technique can be put together using commercially available items. It is the intent of this discussion to provide enough detail and explanation so that a technician with some working knowledge of microwave measurements can set up and make loss measurements.

The reference made to two-ports implies a broad range of devices from a simple flange or connector to waveguide coaxial adaptors and even more elaborate configurations with a definable input and output connection.

TN645. **Time and frequency broadcast experiments from the ATS-3 satellite,** D. W. Hanson and W. F. Hamilton, Nat. Bur. Stand. (U.S.), Tech. Note 645, 115 pages (Nov. 1973) $1.00, SD Catalog No. C13.46:645.

Key words: Dissemination; frequency; satellites; synchronization; time.

An experiment designed to reveal the advantages and special problems associated with the broadcasting of time and frequency information from geostationary satellites is discussed. Included are discussions concerning satellite motion, time delay variation, doppler shift due to the motion, and calculation of delay. Receiver or ground station equipment requirements, time recovery techniques, timing resolution and accuracy, and special advantages of satellite broadcasts for time and frequency dissemination are also discussed. Specially equipped sites in North and South America gathered data from the experimental satellite broadcast which in turn were used to determine the potential accuracy of satellite dissemination, the results of which are presented. Delay computation aids for the user were designed to provide a simple and inexpensive means of computing free space delays between the master clock and the user via a geostationary satellite. The aids, delay overlays on an earth map and a circular slide rule, are discussed with examples. Qualitative discussions of the signals and broadcast format are given. Final comments are made concerning the results of the experiment and how they might reflect upon a final system design for a permanent service using one or more geostationary satellites.

TN710-6. **Building research translation: Ventilation air inlets for**

**dwellings,** M. Croiset and H. Bizebard, Nat. Bur. Stand. (U.S.), Tech. Note 710-6, 62 pages (Jan. 1973) $1.00, SD Catalog No. C13.46:710-6.

Key words: Air inlet; discomfort index; draft; outside wall; ventilation; wind.

Preliminary tests have shown the existence of a "discomfort index," a function firstly of the difference between the temperature in the room and the temperature of the air current and, secondly of the speed of the air stream. The permissible limit for this index has been fixed at 2 °C, at least in that part of the room situated more than 20 cm from the outside walls and less than 2 meters in height.

Systematic artificial tests have resulted in satisfactory solutions being found for the air inlets into the outside walls.

- An elongated aperture placed above a radiator and fitted with a deflector so that cold air entering the room mingles with the ascending warm air current.
- An aperture located behind a convector heater so that the same result is achieved as in the case of the radiator.
- A row of apertures located along the heated ceiling placed so that entering air is diffused into the warm air before reaching the occupied zone.

Some calculations aimed at determining the orders of magnitude of the necessary sections and the possible force of the air current in a high wind, have revealed the need for a manual or an automatic regulator where a wall is exposed to wind.

TN710-7. **Building research translation: Weak thermal points or thermal bridges,** J. Berthier, Nat. Bur. Stand. (U.S.), Tech. Note 710- 7, 96 pages (May 1973) $1.25, SD Catalog No. C13.46:710-7.

Key words: Floors and panels; moisture condensation; thermal bridges; thermal insulation; U-values of walls.

Uniformity of temperature on the internal face is one of the essential hygrothermal qualities for a wall.

Cold bridges, which are the cause of uneven temperatures, constitute a weakness which ought to be corrected.

The author describes a large number of tests carried out with various types of wall (dense walls and lightweight panels) in order to assess the importance of cold bridges and to determine the effectiveness of possible remedies; he shows that the accepted theory used in the calculation of U-coefficients is unsatisfactory when estimating surface temperatures. The results obtained can be explained, however, by means of two simple hypotheses; on the basis of these there are practical rules which can be used in establishing the importance of cold bridges, and recommendations for reducing them.

TN740. **SETAB: An edit insert program for automatic typesetting of spectroscopic and other computerized tables,** R. C. Thompson and J. Hilsenrath, Nat. Bur. Stand. (U.S.), Tech. Note 740, 30 pages (Dec. 1973) 55 cents, SD Catalog No. C13.46: 740.

Key words: Automatic typesetting; computer-assisted typesetting; edit insertion program; FORTRAN program; phototypesetting of spectroscopic tables; typesetting of tables.

SETAB is a FORTRAN program which accepts a card deck or FORTRAN records on magnetic tape and inserts the appropriate flags and shift symbols required by many programs associated with phototypesetting devices. The program is specialized to the particular application, the phototypesetter and typography programs, and to the desired typefaces by means of parameter cards supplied at run time. Examples are shown of spectroscopic tables typeset on the Linofilm phototypesetter at the Government Printing Office using the Autoset Typography Program. The program has also been used for tables of other types of data. The program can handle any records which can be read by a FORTRAN "READ" statement under "A" format control. The original record can be divided into as many as 40 fields and these fields can be combined in any order with any of 26 strings in front of or between the pieces. The program will, on a signal, replace a field by another field or by a combination of fields and strings. The output lines are blocked and paged via the insertion of the required strings between blocks and pages.

TN741. **Unassigned.**

TN745. **Neutron dose and fluence distributions in an infinite air medium,** G. L. Simmons and C. M. Eisenhauer, Nat. Bur. Stand. (U.S.), Tech. Note 745, 39 pages (Jan. 1973) 65 cents, SD Catalog No. C13.46:745.

Key words: Benchmark problems; dose distributions; moments method; neutron penetration; shielding; weapons radiation.

The moments method is applied to the problem of calculating the neutron dose and fluence distributions in an infinite medium of air. These calculations are compared with Monte Carlo and Discrete Ordinates ($S_n$) results. Simple parametric representations for the distributions are given which facilitate the calculation of dose and flux distributions in air with a different density.

TN748. **An adjoint gamma-ray moments computer code, ADJ-MOM-I,** G. L. Simmons, Nat. Bur. Stand. (U.S.), Tech. Note 748, 23 pages (Feb. 1973) 30 cents, SD Catalog No. C13.46:748.

Key words: Adjoint; buildup factor; dosimetry; gamma-ray transport; moment methods; shielding.

In this paper we discuss a computer code for generating spatial-angular moments of the adjoint gamma-ray flux in an infinite medium. The equation for the flux moments is given and techniques used for the solution are described. Details of the input data and a sample problem are also supplied.

TN751. **Studies of calibration standards used in the Department of Defense Equipment Oil Analysis Program,** D. W. Golightly and J. L. Weber, Nat. Bur. Stand. (U.S.), Tech. Note 751, 48 pages (Jan. 1973) 75 cents. SD Catalog No. C13.46:751.

Key words: Calibration standards; concentration validity; flash point; lubricating oil; pour point; spectrometric analysis; stability; trace elements; viscosity.

At the request of the Naval Systems Air Command, Department of the Navy, studies have been conducted on organo-metallic calibration standards and diluent oil used in the Department of Defense Equipment Oil Analysis Program. Consultation on standards has been provided, and measurements of physical properties of base oil, concentrations of major elements in standards, concentrations of trace contaminants, and stability of solutions have been performed. Results of studies accomplished in fiscal year 1972 are detailed in this report.

TN752. **Directory of law enforcement and criminal justice associations and research centers,** B. J. Latka, Nat. Bur. Stand. (U.S.), Tech. Note 752, 49 pages (June 1973) 80 cents. SD Catalog No. C13.46:752.

Key words: Associations; criminal justice; directory, law enforcement; research centers.

This directory lists national, non-profit professional and volun-

teer social action associations and research centers which are active in the fields of law enforcement and criminal justice. The International and foreign organizations which are listed either have a large number of American members, have a United States chapter, or are doing work which is applicable to the United States. The local organizations which are listed either cover several states or are of national interest. The organizations are listed alphabetically with a subject index included. The format of an entry is: title of organization; mailing address; officer; telephone number; year when founded; number of members, number of staff; description of purpose and activities; affiliations; publications, meetings.

TN753. **NBS Special Foreign Currency Program in Yugoslavia 1971-72,** H. S. Peiser, S. E. Chappell, E. Horowitz, H. Yakowitz, and D. Bluebond, Nat. Bur. Stand. (U.S.), Tech. Note 753, 72 pages (Jan. 1973) 90 cents, SD Catalog No. C13.46:753.

Key words: Binational research cooperation; international scientific cooperation; physical science research administration; research planning; scientific research abstracts; Special Foreign Currency Program; Yugoslavia science and technology.

An overview is given of grants awarded by the National Bureau of Standards under the Special Foreign Currency Program (SFCP) in Yugoslavia, authorized by Public Law 480 and other legislation. Each grant is identified by title, principal investigator, institution in Yugoslavia, NBS monitor, and the monitor's organizational unit within NBS. The work is then described briefly under the three headings "Summary Description of Project Goals," "Results and Implications to Date" and "List of Publications that Resulted from the Project." To demonstrate the relevance of such grants to the programs of NBS, the grant descriptions are ordered by the elements of that Program Structure. The significance and purpose of the NBS/SFCP grant program are discussed in the Foreword, the Introduction and an Appendix. The NBS monitors and the program manager judge this grant program to have had a high benefit to cost ratio from the viewpoint of NBS.

TN754. **Methods of measurement for semiconductor materials, process control, and devices. Quarterly report July 1 to September 30, 1972,** W. M. Bullis, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 754, 55 pages (Mar. 1973) 80 cents, SD Catalog No. C13.46:754.

Key words: Aluminum wire; base transit time; carrier lifetime; die attachment; electrical properties; epitaxial silicon; gamma-ray detectors; generation centers; germanium; gold-doped silicon; infrared response; methods of measurement; microelectronics; microwave diodes; nuclear radiation detectors; probe techniques (a-c); recombination centers; resistivity; ribbon wire bonding; semiconductor devices; semiconductor materials; semiconductor process control; silicon; thermal resistance; trapping centers; ultrasonic bonding; wire bonds.

This quarterly progress report, seventeenth of a series, describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. Significant accomplishments during this reporting period include design of a plan to provide standard silicon wafers for four-probe resistivity measurements for the industry, publication of a summary report on the photoconductive decay method for measuring carrier lifetime, publication of a comprehensive review of the field of wire bond fabrication and testing, and successful completion of organizational activity leading to the establishment of a new group on quality and hardness assurance in ASTM Committee F-1 on Electronics. Work is continuing on measurement of resistivity of semiconductor crystals; characterization of generation-recombination-trapping centers in silicon; study of gold-doped silicon; development of the infrared response technique; evaluation of wire bonds and die attachment; and measurement of thermal properties of semiconductor devices, delay time and related carrier transport properties in junction devices, and noise properties of microwave diodes. New efforts were initiated in both the die attachment and wire bond evaluation tasks. Supplementary data concerning staff, standards committee activities, technical services, and publications are included as appendixes. A description of breakdown tracks, a primary failure mode of monolithic integrated circuits stressed with voltage pulses, is given in a separate appendix.

TN755. **Some aspects of the setting and hardening of gypsum plaster,** J. R. Clifton, Nat. Bur. Stand. (U.S.), Tech. Note 755, 33 pages (Jan. 1973) 55 cents, SD Catalog No. C13.46:755.

Key words: Colloidal theory; crystallization theory; gypsum; hydration; induction period; plaster of paris; setting mechanisms.

The mechanisms by which gypsum plaster sets and hardens have been investigated and the results generally are consistent with the crystallization theory. No evidence for the presence of colloidal intermediates has been found. The crystallization theory is modified to include, as an intermediate species, solvated calcium sulfate hemihydrate molecules. Evidence is presented that supports the belief that more than one reaction is responsible for the setting and hardening of gypsum plaster.

The roles of accelerators and retarders have been studied by calorimetric, differential thermal analysis, and scanning electron microscopic techniques. The cation is more effective than the anion in accelerating the setting and hardening of gypsum plasters; the catalytic order follows the sequence $M^{+}$ $M^{2+}$ $M^{3+}$. Small amounts of retarders can severely retard the setting and hardening processes.

Influences of temperature, impurities, and production conditions on the setting rates of gypsum plasters are discussed.

TN756. **A user's guide to the OMNITAB command "STATISTICAL ANALYSIS,"** H. H. Ku, Nat. Bur. Stand. (U.S.), Tech. Note 756, 44 pages (Mar. 1973) 75 cents, SD Catalog No. C13.46:756.

Key words: Computing, statistical; documentation for users; OMNITAB; statistics.

This Technical Note is the first of a series of interpretive notes for a number of commands in the OMNITAB system that have the automatic printout feature. Others planned in the series include commands FIT and POLYFIT, TWOWAY analysis, ONEWAY analysis, and CORRELATION.

These notes aim to be self-contained so that users may have sufficient information on hand for the understanding of the statistics computed and to use them for their immediate applications. Computation formulas are given in the text, and a number of statistical tables are reproduced in the Appendix for the convenience of users.

TN757. **The smoke density chamber method for evaluating the potential smoke generation of building materials,** T. G. Lee, Nat. Bur. Stand. (U.S.), Tech. Note 757, 20 pages (Jan. 1973) 45 cents, SD Catalog No. C13.46:757.

Key words: Building materials; fire; fire services; smoke; smoke density chamber; smoke potential; test method; visibility.

The paper reviews the Smoke Density Chamber Test Method and illustrates its use and application to assess smoke generation of building materials in fire situations. It shows how test results may aid the Fire Services and code authorities in evaluating and reducing the potential light-obscuration hazard of smoke in buildings. An example is given for calculating visibility in a simplified fire situation involving material of known smoke generation. The smoke generation of some common interior finish and construction materials is given.

TN758. **NBS reactor: Summary of activities October 1971 to September 1972,** R. S. Carter, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 758, 140 pages (Mar. 1973) $2.10, SD Catalog No. C13.46:758.

Key words: Activation analysis; crystal structure; diffraction; isotopes; molecular dynamics; neutron; nuclear reactor; radiation.

This report summarizes all those programs which depend on the NBS reactor. It covers the period from October 1971 through September 1972. The programs range from the use of neutron beams to study the structure and dynamics of materials through nuclear physics and neutron standards to sample irradiations for activation analysis, isotope production, and radiation effects studies.

TN759. **The NBS lead paint poisoning project: Housing and other aspects,** H. W. Berger, Nat. Bur. Stand. (U.S.), Tech. Note 759, 25 pages (Feb. 1973) 30 cents, SD Catalog No. C13.46:759.

Key words: Hazard elimination; lead analysis; lead paint; lead poisoning.

The National Bureau of Standards is providing technical support required by the Department of Housing and Urban Development to carry out its research responsibilities under PL 91-695, The Lead Based Paint Poisoning Prevention Act. The program at NBS has involved three major areas of research: (1) an estimation of the numbers of children at risk and with excessive body burdens of lead and the geographical distribution of those children; (2) the capabilities and characteristics of analytical methods for the detection of lead in paint and other building materials; and (3) the identification and evaluation of materials, techniques and systems for removing or eliminating the lead paint hazard from housing. This paper is a brief presentation of the activities and conclusions of NBS in the areas listed above.

TN760. **Description of the magnetic tape version of the Bulletin of Thermodynamics and Thermochemistry, No. 14 (1971),** R. McClenon, W. H. Evans, D. Garvin, and B. C. Duncan, Nat. Bur. Stand. (U.S.), Tech. Note 760, 51 pages (Mar. 1973) 75 cents, SD Catalog No. C13.46:760.

Key words: Bibliography; chemical thermodynamics; extended character codes; information retrieval; magnetic tape.

The substance-property index and bibliography sections of the Bulletin of Thermodynamics and Thermochemistry, No. 14 (May 1971) have been converted to a magnetic tape version designed for computerized searching written in an extended form of the American National Standard Code for Information Interchange (X 3.4-1968). In this version each substance-property entry has been supplemented by a searching key. This report describes the magnetic tape version.

TN761. **Project SOAP: A systems approach to biomedical research program management—A case study,** R. S. Cutler, Nat. Bur. Stand. (U.S.), Tech. Note 761, 75 pages (Apr. 1973) 95 cents, SD Catalog No. C13.46:761.

Key words: Biomedical research; "health relevance"; program planning and budgeting; R&D management; systems analysis; systems approach.

This case study describes the activities of an interagency task group that applied systems analysis to improve management controls within a biomedical research agency of the federal government. The results were the formulation and implementation of a discipline for program management, which explicitly makes use of multiple criteria in arriving at resource allocation decisions.

The text details the necessary preliminary analysis describing operational activities, information flows, and key decision points within the organization. It goes on to identify the techniques employed and the difficulties encountered while attempting to improve the decision-making process for selecting research projects, under conditions of reduced funding. In particular, a comparison is made between: (1) the agency's traditional single-criterion "peer review" judgment for determining budget priorities, and (2) the multiple-criteria judgments required to effect more positive management control. The systematic use of separate "scientific merit" and "health relevance" ratings is compared with the organization's actual experience. The criteria used by various participants in the decision process are analyzed, and a dollar allocation "investment" procedure based on these findings is developed.

A procedure which organizes relevant information for research program planning and evaluation is presented, and extension of this recommended procedure to wider use by science administrators elsewhere in government is discussed.

TN762. **Tabulation of voluntary standards and certification programs for consumer products,** S. J. Chumas, Nat. Bur. Stand. (U.S.), Tech. Note 762, 119 pages (Mar. 1973) $1.25, SD Catalog No. C13.46:762.

Key words: Certification programs; consumer products; household products; industry standards; international recommendations; national standards; product standards; recommended practices; specifications; test methods.

This tabulation is a revised and enlarged version of NBS Technical Note 705, "Tabulation of Voluntary National Standards, Industry Standards, International Recommendations and Certification Programs for Consumer Products," issued December 1971.

Technical Note 705 was a revision of the Draft Tabulation compiled by the American National Standards Institute and issued in April 1970. The categories and products covered in the tabulation were originally based on those listed in the Consumer Product Safety Index (CPSI) of the National Commission on Product Safety, published in July 1970. The products and categories in the current revision are based on those developed for the National Electronic Injury Surveillance System (NEISS) of the Food and Drug Administration. The NEISS listings are an expansion and revision of the CPSI. NEISS product areas were slightly altered to conform to the scope of this tabulation.

The tabulation lists over 700 product areas and over 1000 standards' titles covering products found in and around the home. (The major consumer product areas not included are foods, beverages, and drugs.) The tabulation also indicates the applicable voluntary national, industrial, and international standards which deal primarily with either safety or performance or both aspects of the products listed. For some of the product areas, there are no applicable standards. Available information on certification programs and standards under development, and the Standard Industrial Classification (SIC) numbers for the products are also provided. Supersedes NBS Technical Note 705.

TN763. **A set of debugging and monitoring facilities to improve the diagnostic capabilities of a compiler,** E. N. Fong, Nat. Bur. Stand. (U.S.), Tech. Note 763, 25 pages (Mar. 1973) 50 cents, SD Catalog No. C13.46:763.

Key words: Compiler; debugging; error diagnostic; high-level programming languages; monitoring; procedural-oriented languages.

Increasing concern with the quality of computer software today makes it important to evaluate critically the debugging facilities available in high-level languages. This paper presents a collection of program debugging and monitoring facilities to improve the diagnostic capabilities of a compiler. A distinction is made between debugging and monitoring facilities performed at compile time, at link/load time and at execution time. These facilities are described in terms of this breakdown with a conscious attempt to move the detection of errors from execution time to compile or link/load time, and to collect information when the information is available during the compilation process.

TN764. **An investigation of the stability of and insulation leakage in some high temperature resistance thermometers: An interim report,** S. D. Wood, Nat. Bur. Stand. (U.S.), Tech. Note 764, 31 pages (May 1973) 50 cents, SD Catalog No. C13.46:764.

Key words: Freezing point of zinc; high temperature resistance thermometer; insulation resistance; platinum resistance thermometer; resistance thermometer; stability; tungsten thermometer; zinc.

Data are presented concerning the stability of high temperature resistance thermometers. Two types of platinum and one type of tungsten thermometer were tested at 1065 °C and 960 °C. Some of the platinum thermometers were also tested at 900 °C and at the freezing point of zinc. Results of tests are also given on the insulation resistance of sensor supports and lead assemblies for the two types of platinum thermometers. A new design for a zinc-point cell is discussed briefly. Suggestions for future work are indicated.

TN765. **Low temperature thermometry: Interim report,** G. Cataland and H. H. Plumb, Nat. Bur. Stand. (U.S.), Tech. Note 765, 23 pages (May 1973) 40 cents, SD Catalog No. C13.46:765.

Key words: Acoustical thermometer; calibrator; germanium thermometers; heat conduction; NBS P2-20 (1965) scale; "speed of sound" isotherms; viscosity.

Earlier acoustical thermometer "speed of sound" isotherms are compared with recent measurements. Where systematic deviations had appeared in "smoothing" through acoustically derived temperatures via germanium thermometers, a possible solution has emerged; more precise temperature control of the acoustical thermometer is desirable and has been realized. A cursory examination of the applicability of the Helmholtz-Kirchhoff equation was made with a modified sonic chamber. Measurements with the modified instrument have shown no changes in the experimental results.

The maintenance of the NBS P2-20 (1965) scale is described. A new calibration apparatus was constructed to accommodate more germanium thermometers thus reducing the calibration cost per thermometer during a calibration run.

TN766. **A gamma ray moments computer code, GAMMOM-I,** C. M. Eisenhauer, G. L. Simmons, and L. V. Spencer, Nat. Bur. Stand. (U.S.), Tech. Note 766, 41 pages (Apr. 1973) 75 cents, SD Catalog No. C13.46:766.

Key words: Computer code; gamma rays; gamma ray transport; gauss quadrature; moments; shielding.

In this paper we describe a computer code for generating spatial-angular moments of gamma ray energy fluence in an infinite medium. The equation for moments of the energy fluence is given and the techniques used for the solution are discussed. The structure of the code and of the main subroutines is also given. Details of the input and output data are presented and the printout from a sample problem is included.

TN767. **Microelectronic interconnection bonding with ribbon wire,** H. K. Kessler and A. H. Sher, Nat. Bur. Stand. (U.S.), Tech. Note 767, 31 pages (Apr. 1973) 50 cents, SD Catalog No. C13.46:767.

Key words: Aluminum wire; bonding; fabrication (wire bonds); microelectronics; ribbon wire; round wire; testing (wire bond); ultrasonic bonding; wire bond.

The feasibility of using aluminum ribbon wire for ultrasonic bonding of semiconductor microelectronic interconnections was studied, and several advantages over the use of round wire of equivalent cross-sectional area were found. Ribbon wire bonds exhibited little deformation or heel damage, and a greater percentage of bonds of a certain quality (as judged by pull strength and appearance) could be made over much greater ranges of the bonding machine parameters, time and tool tip displacement, using ribbon wire than was possible with round wire. The ease of positioning ribbon wire was indicated by making multiple ribbon wire bonds side-by-side on a 5-mil square pad, or by stacking up to four bonds one on top of another. However, bonding with harder than normal wire, previously thought to offer certain advantages with respect to higher bond tensile strength, yielded inconsistent results.

TN768. **Nonmetallic coatings for concrete reinforcing bars. Coating materials,** J. R. Clifton, H. F. Beeghly, and R. G. Mathey, Nat. Bur. Stand. (U.S.), Tech. Note 768, 40 pages (Apr. 1973) 65 cents, SD Catalog No. C13.46:768.

Key words: Chlorides; concrete; corrosion; epoxy coatings; organic coating; steel reinforcing bars.

This work was undertaken in order to determine the feasibility of using organic coatings, especially epoxies, to protect steel reinforcing bars embedded in concrete from accelerated corrosion attributed to the depassivation of steel by chloride ions.

Coatings have been evaluated on the basis of their chemical and physical durabilities as well as their protective qualities. In this study, attention has also been directed to the following: application methods; surface preparation of the steel reinforcing bar; and site of application.

TN769. **A rigorous correction procedure for quantitative electron probe microanalysis (COR 2),** J. Hénoc, K. F. J. Heinrich, and R. L. Myklebust, Nat. Bur. Stand. (U.S.), Tech. Note 769, 132 pages (Aug. 1973) $2.10, SD Catalog No. C13.46:769.

Key words: Continuum fluorescence; data reduction; electron probe microanalysis; fluorescence correction; quantitative analysis.

This publication describes a rigorous data reduction procedure for quantitative electron probe microanalysis, which avoids simplifications present in conventional schemes. In addition, the program contains a correction for fluorescence due to the continuum, and separate computation of the fluorescent effects of each exciting primary x-ray line. Constants characteristic of elements are stored in a permanent data file, and the constants and parameters needed for the calculation of mass absorption coefficients are contained in a sub-program. These provisions and

decision-making sections in the development of the fluorescence corrections reduce the required input considerably.

TN770. **Hazard elimination procedures for leaded paints in housing,** D. Waksman, L. F. Skoda, and E. J. Clark, Nat. Bur. Stand. (U.S.), Tech Note 770, 99 pages (May 1973) $1.25, SD Catalog No. C13.46:770.

Key words: Building material; housing; leaded paint; lead hazard elimination methods; lead paint poisoning; performance attributes.

Methods currently used to control the hazard caused by leaded paints in housing vary in effectiveness from complete elimination of the hazard to a minimal effort that runs a high risk for recurrence of the hazard. A series of guidelines has been drawn up to acquaint municipal planners and other decision makers with the factors that should be considered in implementing a hazard elimination program. Formats are presented to describe attributes of the various methods that should be considered.

TN771. **Some experiments on the stirring of viscous liquids,** A. Napolitano, Nat. Bur. Stand. (U.S.), Tech. Note 771, 60 pages (May 1973) 85 cents, SD Catalog No. C13.46:771.

Key words: Agitators; borosilicate glass; glass melt; glass tank; liquids; stirrer; viscosity.

The stirring actions of several designs of small stirrers were observed and photographed in transparent viscous model liquids. The fluidity of the liquids was comparable to that of a molten borosilicate glass at fining temperatures. The most efficient features of one or more of these stirrers were incorporated into larger model stirrers and observed under actual stirring conditions. As a result of these performance tests, a final design of stirrer was selected and fabricated of platinum-rhodium metal and used in an experimental glass tank. The design of one of the pots in the experimental glass tank was modified to obtain the maximum stirring action with the selected stirrer.

TN772. **A performance comparison of labeling algorithms for calculating shortest path trees,** J. Gilsinn and C. Witzgall, Nat. Bur. Stand. (U.S.), Tech. Note 772, 92 pages (May 1973) $1.25, SD Catalog No. C13.46:772.

Key words: Algorithms; networks; paths; shortest-paths; trees.

Many applications in transportation and communication require the calculation of shortest routes between points in a network, and several algorithms for the solution of this problem exist in the literature. This paper examines one class of such algorithms, that which calculates a shortest route from one point in the network to all other intersection points. Computer data handling techniques which can be used to improve the two basic algorithms in this class are investigated. Results of computer timing runs on various types and sizes of networks are compared, and the differences, sometimes of an order of magnitude, are analyzed. Detailed flowcharts and computer programs of the tested algorithms are also included.

TN773. **Methods of measurement for semiconductor materials, process control, and devices. Quarterly report, October 1 to December 31, 1972,** W. M. Bullis, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 773, 56 pages (June 1973) 80 cents, SD Catalog No. C13.46:773.

Key words: Base transit time; carrier lifetime; delay time; die attachment; electrical properties; electronics; epitaxial silicon; four-probe method; generation centers; germanium; gold-doped silicon; infrared response; methods of measurement; microelectronics; microwave diodes; probing techniques (a-c); pull test; recombination centers; resistivity; resistivity standards; semiconductor devices; semiconductor materials; semiconductor process control; silicon; S-parameters; switching transients; thermal resistance; thermally stimulated measurements; trapping centers; wire bonds.

This quarterly progress report, eighteenth of a series, describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. Significant accomplishments during this reporting period include (1) completion of the investigation of the effects of current, probe force, and surface condition on the measurement of resistivity of bulk silicon wafers by the four-probe method, (2) establishment of operating conditions appropriate for determining the sensitivity of transient thermal response measurements to voids in transistor die attachment, and (3) initiation of an interlaboratory comparison of transistor scattering parameter measurements. Because of the general applicability of the first of these, details are presented in a separate appendix. Work is continuing on measurement of resistivity of semiconductor crystals; characterization of generation-recombination-trapping centers in silicon; study of gold-doped silicon; development of the infrared response technique; evaluation of wire bonds and die attachment; measurement of thermal properties of semiconductor devices; determination of S-parameters, delay time, and related carrier transport properties in junction devices; development of a-c probing techniques; and characterization of noise and conversion loss of microwave detector diodes. Supplementary data concerning staff, standards committee activities, technical services, and publications are included as appendices.

TN774. **Fire service location-allocation models,** D. Colner and D. Gilsinn, Nat. Bur. Stand. (U.S.), Tech. Note 774, 46 pages (June 1973) 75 cents, SD Catalog No. C13.46:774.

Key words: Algorithms; fire station location; heuristics; location-allocation models; location analysis; resource allocation analysis; transportation network analysis.

This paper compiles the various types of location-allocation models which analyze the impact of varying the number and location of fire stations. The assumptions of each model, the relationships between models, and possible heuristics and algorithms are discussed. In addition, a methodology of spatial concepts analogous to those used in transportation planning is presented.

TN775. **Coordinated evaluation system (CES) project, model documentation for building regulation,** R. D. Dikkers, Nat. Bur. Stand. (U.S.), Tech. Note 775 (16 pages) 35 cents, SD Catalog No. C13.46:775.

Key words: Building regulation; evaluation; inspection; manufactured building; mobile homes; model documents; state-of-art study.

Background information, objectives and the current status (February 1973) of various tasks and reports pertaining to the Coordinated Evaluation System (CES) project are described. The goal of the CES Project is to develop model informational documentation that will assist state building regulatory agencies in establishing a coordinated and uniform evaluation, approval and inspection system. The model documentation will be related to the following building regulatory functions: (1) data submittal, (2) evaluation, (3) approval, (4) compliance assurance (inspection), (5) installation, and (6) owner information.

TN776. **A new method for generating waterdrops of specified mass,** J. E. Potzick, Nat. Bur. Stand. (U.S.), Tech. Note 776, 12 pages (May 1973) 35 cents, SD Catalog No. C13.46:776.

Key words: Drop generator; liquid drop; waterdrop.

A waterdrop generator has been constructed, based on the mechanical resonance of a vibrating waterdrop, which can generate drops of 1.5 to 37 mg with standard deviations in the range of 0.1 percent to 10 percent of drop mass. Drop mass over this range and drop interval are remotely controlled.

TN777. **Cost analysis of blood banking alternatives,** T. Miller, M. King, J. Flannagan, E. Nilsson, and B. Lemieux, Nat. Bur. Stand. (U.S.), Tech. Note 777, 121 pages (Sept. 1973) $1.35, SD Catalog No. C.13.46:777.

Key words: Blood banks; blood utilization statistics; cost benefit analysis; donor profiles; peer review; regulatory activities; sensitivity analysis.

This report provides a description of the current blood banking system and of the collection and derivation of quantitative information concerning system operation and blood cost. A reasonably accurate but somewhat incomplete profile of practices, attitudes, and likely costs of present and alternative systems has been developed. Among the topics presented are: 1) a discussion of the blood collection process including statistics on present use and future needs; 2) information relating to donor motivation, attitudes and incentives; 3) a brief summary of demonstration programs in the U.S. and national blood programs in other countries which provides some insight concerning means for improving blood quality and availability; 4) a description of blood processing, storage and distribution procedures; 5) narrative and statistical information relating to blood utilization practices; 6) discussions of post transfusion reactions and frozen blood programs; 7) a discussion of current governmental and professional standards, regulations and controls which influence many, but not all, concerns involved in blood collection and processing.

This information serves as the basis for the selection of alternatives analyzed in a cost effectiveness analysis of eight apparently viable alternatives to the current system. Because of the possible variation which might be ascribed to many of the parameters used as a basis for costing alternatives, the sensitivity analysis is crucial in the comparison of alternatives.

TN778. **Guidelines for selection of and use of foam polyurethane roofing systems,** W. C. Cullen and W. J. Rossiter, Jr., Nat. Bur. Stand. (U.S.), Tech. Note 778, 46 pages (May 1973) 75 cents, SD Catalog No. C13.46:778.

Key words: Durability; fire safety; performance guidelines; protective coatings; rigid polyurethane; roofing.

The use of spray-in-place polyurethane foam for roofing application in the United States is increasing at a rapid rate. Little unbiased information is available to guide the user in the specification, selection, application, and performance of this innovative roofing system. This report describes the current state-of-the-art of rigid polyurethane technology as applied to roofing systems. The performance parameters as observed during the field survey are discussed in terms of protective coatings, fire safety, durability and problem areas. Guidelines to assist the supplier and user alike in the use and selection of polyurethane foam roofing systems are given. Finally, a performance specification for spray-in-place polyurethane foam roofing system is suggested.

TN779. **Data communications system throughput performance using high speed terminals on the dial telephone network,** D. S. Grubb, Nat. Bur. Stand. (U.S.), Tech. Note 779, 40 pages (May 1973) 65 cents, SD Catalog No. C13.46:779.

Key words: Data communications; modems; terminals; throughput; TRIB.

Throughput performance of high speed data terminals using the dial telephone network is calculated for signaling rate of 1200 to 4800 bits per second using the ANSI X3.28-1971 control procedures and measured in terms of the proposed ANSI strand TRIB described in X3S35/80. The performance calculations are shown graphically with TRIB as a function of block length, error rates of the telephone connection, signaling rate and telephone line delays. Error rates are based on a published survey involving several hundred telephone connections to geographically distributed parts of the United States.

TN780. **Controlled accessibility bibliography,** S. K. Reed and M. M. Gray, Nat. Bur. Stand. (U.S.), Tech. Note 780, 15 pages (June 1973) 35 cents, SD Catalog No. C13.46:780.

Key words: Confidentiality; controlled accessibility; data integrity; data security; security.

A bibliography of 96 references on controlled accessibility has been compiled. The purpose in compiling this limited bibliography was to free the effort to solve the problems of controlled accessibility from domination by discussion of the issues of privacy. Insofar as possible, except when the two subjects are referred to in the same work or for overriding historical considerations, references dealing with privacy have not been included.

TN781. **A study of six university-based information systems,** B. Marron, E. Fong, D. W. Fife, and K. Rankin, Nat. Bur. Stand. (U.S.), Tech. Note 781, 98 pages (June 1973) $1.25, SD Catalog No. C13.46:781.

Key words: Computer-based systems; information systems, university; university computer systems.

A methodology for categorically describing computer-based information systems was developed and applied to six university-based, NSF-supported, systems. The Systems under study all operate as retail information centers primarily serving campus communities by accessing large commercially-available data bases using 3d generation computer configurations. The systems vary in design philosophy, mode of user service, transferability characteristics, and operational status. A summary matrix is included.

TN783. **Durability and maintenance as related to the selection of flooring,** W. C. Wolfe, R. F. Roberts, and M. Russell, Nat. Bur. Stand. (U.S.), Tech. Note 783, 68 pages (Aug. 1973) 90 cents, SD Catalog No. C13.46:783.

Key words: Carpets; durability; economics; field studies; flooring; floor coverings; life-cost; maintenance; user needs.

This report is addressed to the problem of selection and maintenance of flooring to the best advantage in terms of durability, type and severity of service, appearance, comfort, and safety. The selection of flooring is discussed with respect to service life, maintenance, obsolescence, and trade-off advantages. Two articles by maintenance administrators include information and discussion helpful in determining maintenance cost, trade-offs, and selection of flooring for different types of service. Field observations and preliminary field tests by the National Bureau of Standards indicate areas in which research is needed, as in laboratory tests for wear and slip resistance. Observations and field tests are impracticable to use for procurement.

This report is helpful in the selection and maintenance of flooring and floor finishes. More important, it points up areas in which research is needed to develop information for this purpose.

TN784. **Unassigned.**

TN785. **Scanning electron microscope examination of wire bonds**

**from high-reliability devices,** K. O. Leedy, Nat. Bur. Stand. (U.S.), Tech. Note 785, 35 pages (Aug. 1973) 55 cents, SD Catalog No. C13.46:785.

Key words: Aluminum wire; high reliability; integrated circuit; metallization; scanning electron microscope; transistor; ultrasonic bonding; wire bonding.

An examination with a scanning electron microscope was made of the wire bonds of over 75 high-reliability microelectronic devices. The device interconnects were ultrasonically bonded aluminum wires. Of primary interest were the bonds themselves; their appearance and its significance are described. Also described is the appearance of the metallization and the wire. Comments and explanations are given where the phenomena are understood. Although the devices studied had passed preliminary electrical tests and pre-encapsulation visual examinations, many potential reliability problems were identified such as weak bonds, electrical shorts and contamination.

TN786. **Methods for testing wire-bond electrical connections,** H. A. Schafft, Nat. Bur. Stand. (U.S.), Tech. Note 786, 23 pages (Nov. 1973) 50 cents, SD Catalog No. C13.46:786.

Key words: Bonding; electrical connection; failure (wire bond); integrated circuits; microelectronics; reliability; semiconductor devices; testing (wire bond); wire bond.

A significant fraction of the failures that occur in integrated circuits are due to failures of the wire-bond electrical connections that are used. Therefore, a critical area for reliability improvement is in the methods for testing and evaluating wire bonds. Several of these methods are surveyed. In particular, analyses with regard to the stress that the test imposes on the wire bond in the pull, centrifuge, mechanical shock, vibration, and temperature cycling tests are presented and used in discussing the capabilities and limitations of these methods.

TN787. **Heuristic cost optimization of the Federal Telpak network,** R. G. Saltman, G. R. Bolotsky, and Z. G. Ruthberg, Nat. Bur. Stand. (U.S.), Tech. Note 787, 52 pages (June 1973) 80 cents, SD Catalog No. C13.46:787.

Key words: Communications network; computer program; heuristic; minimum cost; network configuration; optimization; Telpak rate structure.

A heuristic method of optimizing the design of a very large communications network is described. The procedure is employed to configure the routes of 5552 communications service requests involving 1633 nodes. A FORTRAN IV program was developed to solve for actual needs of the Defense Communications Agency for leased-line service employing the Telpak tariff structure.

TN788. **Methods of measurement for semiconductor materials, process control, and devices. Quarterly report January 1 to March 31, 1973,** W. M. Bullis, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 788, 79 pages (Aug. 1973) 95 cents, SD Catalog No. C13.46:788.

Key words: Base transit time; carrier lifetime; delay time; die attachment; electrical properties; electronics; epitaxial silicon; four-probe method; generation centers; germanium; gold-doped silicon; infrared response; methods of measurement; microelectronics; microwave diodes; probing techniques (a-c); pull test; recombination centers; resistivity; resistivity standards; semiconductor devices; semiconductor materials; semiconductor process control; silicon; S-parameters; switching transients; thermal resistance; thermally stimulated properties; trapping centers; wire bonds.

This quarterly progress report, nineteenth of a series, describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. Significant accomplishments during this reporting period include (1) development of a comprehensive, large-area test pattern for evaluating planar junction structures, (2) completion of experimental work on the evaluation of the destructive, double-bond pull test for wire bonds, (3) initiation of a scanning electron microscope facility, and (4) completion of the investigation of the mechanism of emitter-base junction reverse breakdown during rapid switching of transistors. Because of the general applicability of the last of these, details are presented in a separate appendix. Work is continuing on measurement of resistivity of semiconductor crystals; characterization of generation-recombination-trapping centers in silicon; study of gold-doped silicon; development of the infrared response technique; evaluation of wire bonds and die attachment; measurement of thermal properties of semiconductor devices; determination of S-parameters, delay time, and related carrier transport properties in junction devices; development of a-c probing techniques; and characterization of noise and conversion loss of microwave detector diodes. Supplementary data concerning staff, standards committee activities, technical services, and publications are included as appendices.

TN789. **Technical options for energy conservation in buildings,** National Conference of States on Building Codes and Standards and National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings held at the U.S. Department of Commerce Washington, D.C., June 19, 1973, Nat. Bur. Stand. (U.S.), Tech. Note 789, 184 pages (July 1973) $2.35, SD Catalog No. C13.46:789.

Key words: Building design; energy conservation; mechanical systems.

The purpose of this report is to provide reference material on the technical options for energy conservation in buildings. It was prepared for the National Conference of States for Building Codes and Standards-National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings held at the U.S. Department of Commerce in Washington, D.C. on June 19, 1973.

This report describes actions pertinent to existing buildings and new buildings. Regarding existing buildings, principal topics include summer cooling, winter heating, and other energy conserving features—i.e., insulation, fenestration, lighting, appliances, domestic hot water, and human comfort. Suggested actions include those which can be accomplished voluntarily or without expense, and also actions which require some modest effort or expense on the part of the building owner or occupant.

Regarding new buildings, energy conservation actions are described that deal with building design and mechanical systems. The report concludes with a summary of mechanisms for implementation of such actions and criteria for use in evaluation of them.

TN790. **MIDAS modular interactive data acquisition system—description and specification,** C. H. Popenoe and M. S. Campbell, Nat. Bur. Stand. (U.S.), Tech. Note 790, 49 pages (Aug. 1973) 75 cents, SD Catalog No. C13.46:790.

Key words: Computer-controlled experiment; computer interfacing; data acquisition system; digital interface; instrumentation; laboratory automation; MIDAS; programmable controller.

The task of interfacing experiments to computers and data-logging systems should be made as painless as possible for the scientist. With this intent, MIDAS, a user-oriented, modular digital interface system based on CAMAC hardware and

USASCII-bus data communication has been developed. MIDAS modules enable the experimenter to set up, program, modify and operate automated or computer-controlled experiments independently of the experts. Salient features of the concept are described and operating configurations discussed both with and without computer control. System interface requirements are specified in sufficient detail to enable one skilled in the art to design and construct modules operable within a MIDAS system.

TN791. **Dose calibrator pilot study,** S. B. Garfinkel and G. J. Hine, Nat. Bur. Stand. (U.S.), Tech. Note 791, 7 pages (Aug. 1973) 30 cents, SD Catalog No. C13.46:791.

Key words: Dose calibrators; indium-113m; molybdenum-99; nuclear medicine; radiopharmaceuticals; technetium-99m; tin-113.

Results of measurements of six sources in dose calibrators used in nuclear medicine facilities at eight hospitals in the Washington metropolitan area are given.

TN792. **Investigation of viscous flow in glass during phase separation,** J. H. Simmons, S. A. Mills, A. Napolitano, D. H. Blackburn, and W. K. Haller, Nat. Bur. Stand. (U.S.), Tech. Note 792, 43 pages (Sept. 1973) 65 cents, SD Catalog No. C13.46:792.

Key words: Glass; microstructure; phase separation; viscosity.

The isothermal viscosity of two borosilicate glasses, of which one is a commercial glass widely used for chemical glassware, shows a large increase (4 to 5 orders of magnitude) with heat-treatment time (ranging up to 100,000 min) near the annealing point. The two glasses have similar compositions, but differ greatly in their phase separation characteristics. Electron micrographs are used to analyze the development of microstructure during the suspected phase separation. In both glasses, it is found that the structure development is primarily responsible for the viscosity increase. An analysis of the data, and a theoretical interpretation of the effect are presented.

TN793. **Development of a procedure for measuring the noise of paper caps,** M. A. Cadoff, D. E. Mathews, and D. S. Blomquist, Nat. Bur. Stand. (U.S.), Tech. Note 793, 23 pages (Oct. 1973) 50 cents, SD Catalog No. C13.46:793.

Key words: Acoustics; cap guns; children; consumer safety; hearing damage; noise; paper caps; standard apparatus; toys.

In recent years, a great concern has been expressed for consumer protection and safety, especially for children. As an outgrowth of this concern, acoustical testing of potentially hazardous noise-producing toys has been carried out at the National Bureau of Standards for the Bureau of Product Safety (FDA) under the authority of the Toy Safety Act of 1969. This paper discusses in detail the testing work carried out on commercial cap guns and caps, which culminated in the development of a standard firing apparatus for testing paper caps. Engineering drawings of the standard apparatus are given as well as a recommended procedure for using this apparatus to test paper caps.

TN794. **NBS corridor fire tests: Energy and radiation models,** F. C. W. Fung, R. Suchomel, and P. L. Oglesby, Nat. Bur. Stand. (U.S.), Tech. Note 794, 127 pages (Oct. 1973) $1.40, SD Catalog No. C13.46:794.

Key words: Ceiling radiation; corridor fires; critical energy input; flame spread, calculation, and observations; floor covering evaluations; heat balances; heat transfer mechanisms; models, energy balance, radiation, and scaling.

The NBS corridor fire program is a continuing program to investigate the growth and spread of fire and smoke through a corridor when fire is initiated in an adjoining room. Due to recent fires involving floor coverings [1], and controversies over current floor covering flammability test methods, floor coverings have received special attention during the first phase of the corridor fire program. Results of the NBS program on corridor fires are presented under the unifying concepts of energy and radiation models. The major findings are: (1) One type of carpet fire hazard has been identified as the rapid flame spread over pile surface; (2) The dominant mechanism that causes this flame spread is energy transfer from ceiling radiation. This is substantiated by measurements and calculations; (3) Carpet evaluation by critical cumulative energy input into the corridor has been found to be feasible and informative in terms of heat transfer mechanisms; (4) Finally, a radiant panel test appears to be a promising approach to simulate the corridor environment for second generation flooring tests.

TN795. **Review of network management problems and issues,** A. J. Neumann, Nat. Bur. Stand. (U.S.), Tech. Note 795, 77 pages (Oct. 1973) $1.00, SD Catalog No. C13.46:795.

Key words: Academic computing; networks; network management; regional networks; research computing.

Computer networking is broadly considered including hardware, software, procedures and people. Networking encompasses many activities; such as, creation of network products, distribution processes, user activities, and supporting services like marketing, documentation, information services and maintenance. Network management covers both the establishment of networking operations and actual operation of the network facilities. It includes all management functions performed at such network nodes as computing centers, documentation facilities, and service distribution centers. In order to survey the problems facing development of network management, user requirements and system requirements are outlined in a qualitative manner. Examples of political, economic and legal constraints are summarized, such as the economic impact of extended networks on regional and local computing activities. Critical issues for networking management, and other areas of significant management concern are outlined. Organizational alternatives are conceived in terms of a four layer organization model. Conclusions deal with continuing problem areas, the need for a structural model for network management, critical experiments and tasks to be undertaken to further networking capabilities, and a suggestion to establish planning teams to initiate some of the initial steps required for further networking development.

TN796. **FRAME: An on-line correction procedure for quantitative electron probe microanalysis,** H. Yakowitz, R. L. Myklebust, and K. F. J. Heinrich, Nat. Bur. Stand. (U.S.), Tech. Note 796, 51 pages (Oct. 1973) 80 cents, SD Catalog No. C13.46:796.

Key words: Electron probe; mini-computer; on-line correction; quantitative microanalysis.

A procedure using a mini-computer for on-line correction of x-ray data from electron microprobe analysis has been developed. This program, called FRAME, allows mass fractions to be computed on-line by the ZAF approach. Besides x-ray intensities, the only input data required are the atomic numbers of the elements present, the analytical line being used, and the operating voltage. Other required parameters such as atomic weights and x-ray mass attenuation coefficients are stored or calculated by the program. FRAME is in FORTRAN IV, and requires about 4K of computer core. Results from FRAME are very close to those of COR2, which is considered to be the most accurate program available for quantitative electron probe microanalysis.

TN797. **Static language analysis,** G. Lyon, Nat. Bur. Stand. (U.S.), Tech. Note 797, 23 pages (Oct. 1973) 50 cents, SD Catalog No. C13.46:797.

Key words: Data archives; language use; programming aids; programming languages; source-statement analysis; syntax analysis.

Although many variants of programming languages exist, little information is available on how language features are actually used by programmers. Several data collection schemes are discussed here; each would provide empirical data on language use. Some internal details are given for analyzers for FORTRAN and COBOL. In addition, a suggestion is made for a special systems option which would allow a compiler to continuously record source statement characteristics or programs given to it.

TN798. **Collaborative research program between NBS and Indian Scientific Institutions. Special foreign currency program 1973 status,** H. S. Peiser, M. B. McNeil, and D. M. Bluebond, Editors, Nat. Bur. Stand. (U.S.), Tech. Note 798, 139 pages (Nov. 1973) $1.50, SD Catalog No. C13.46:798.

Key words: Binational research cooperation; international scientific cooperation; India science and technology; physical science research administration; research planning; scientific research abstracts; Special Foreign Currency.

An overview is given of grants awarded by the National Bureau of Standards under the Special Foreign Currency Program in India, authorized by Public Law 480 and its amendments. Each grant is identified by title, principal investigator, institution in India, NBS monitor charged with working in close technical touch with the project in India, and the monitor's organizational unit within NBS. The relevant work is then described briefly under the three headings "Summary Description of Project Goals," "Results and Implications to Date," and "List of Publications that Resulted from the Project." To demonstrate the wide use of such grants over the entire Program Structure of NBS, the grant descriptions are ordered by the elements of that Program Structure. Editorial comment on the significance and purpose of the NBS/SFCP grant program is confined to a Foreword and Introduction. The editors judge this grant program to have had a high benefit to cost ratio from the viewpoint of NBS.

TN799. **User procedures standardization for network access,** A. J. Neumann, Nat. Bur. Stand. (U.S.), Tech. Note 799, 43 pages (Oct. 1973) 70 cents, SD Catalog No. C13.46:799.

Key words: Network access procedures; networking; standardization; user protocols.

User access procedures to information systems have become of crucial importance with the advent of computer networks, which have opened new types of resources to a broad spectrum of users. This report surveys user access protocols of six representative systems. Functional access requirements are outlined, and implementation of access procedures is analyzed by means of a common methodology.

Qualitative assessment of standardization possibilities identify standardization candidates such as: system and user signals, on-line user entries, system requests, and network wide categories of message content.

TN802. **Network user information support,** A. J. Neumann, Nat. Bur. Stand. (U.S.), Tech. Note 802, 27 pages (Dec. 1973) 60 cents, SD Catalog No. C13.46:802.

Key words: Computers; consultation; documentation; information support; networks; on-line support; user needs; user support.

With increasing interest in the development of computer networks and the proliferation of remote entry capability from user terminals, user support takes on new dimensions. Some user characteristics are outlined as they affect user support. User support requirements are identified for training, terminal operation, and general information to aid in network operations. Support capabilities include on-line aids, information available on request, and tutorial information available at the terminal. User support also includes pertinent documentation and human consultation. Areas of future research are identified as: interactive language design, tutorial design, integration of hard-copy and on-line capabilities, and further development of user feedback capability.

TN806. **Methods of measurement for semiconductor materials, process control, and devices. Quarterly report April 1 to June 30, 1973,** W. M. Bullis, Editor, Nat. Bur. Stand. (U.S.), Tech. Note 806, 77 pages (Nov. 1973) $1.00, SD Catalog No. C13.46:806.

Key words: Beam leads; carrier lifetime; delay time; die attachment; electrical properties; electronics; epitaxial silicon; generation centers; gold-doped silicon; methods of measurement; microelectronics; microwave diodes; mobility; pull test; recombination centers; resistivity; resistivity standards; scanning electron microscopy; semiconductor devices; semiconductor materials; semiconductor process control; silicon; S-parameters; spreading resistance; thermal resistance; thermally stimulated properties; trapping centers; wire bonds.

This quarterly progress report, twentieth of a series, describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. Significant accomplishments during this reporting period include (1) completion of an initial identification of the more important problems in process control for integrated circuit fabrication and assembly as a basis for and expanded effort to be conducted in cooperation with ARPA, (2) completion of preparations for making silicon bulk resistivity wafer standards available to the industry, and (3) undertaking of new work to establish the relationship between carrier mobility and impurity density in silicon and to investigate test patterns for use in process control and evaluation. Because of the general applicability of the first of these, a summary of the findings is presented in a separate appendix. Work is continuing on measurement of resistivity of semiconductor crystals; characterization of generation-recombination-trapping centers, including gold, in silicon; evaluation of wire bonds and die attachment; study of scanning electron microscopy for wafer inspection and test; measurement of thermal properties of semiconductor devices; determination of S-parameters and delay time in junction devices; and characterization of noise and conversion loss of microwave detector diodes. Supplementary data concerning staff, standards committee activities, technical services, and publications are also included as appendices. This is the last report in this form; future reports in this series will appear under the title, Semiconductor Measurement Technology.

TN807. **Building performance in the 1972 Managua earthquake,** R. N. Wright and S. Kramer, Nat. Bur. Stand. (U.S.), Tech. Note 807, 155 pages (Nov. 1973) $1.60, SD Catalog No. C13.36:807.

Key words: Building codes; buildings; earthquakes; hazards; natural disasters; structures.

Following the Managua, Nicaragua, earthquake of Dec. 23, 1972, a team of engineers representing the U.S. Department of Commerce's National Bureau of Standards (NBS) and the National Academy of Engineering (NAE) performed field investiga-

tions in Managua, Nicaragua, from Dec. 26, 1972, to Jan. 4, 1973. The objectives were to assist the Nicaraguan government in surveying major buildings to determine whether each was suitable for emergency use, repairable, or appropriate for clearance. The team also viewed the patterns of successful performance and damage to identify needs for improvements in building practices for mitigation of earthquake hazards and opportunities for more detailed investigations which could provide information for future improvements in practices. In general, the damages cannot be attributed to unusual intensities of ground shaking or severity of surface faulting. Most damages appeared to result from deficiencies in building practices; deficiencies which had been exhibited many times before in previous earthquakes, deficiencies which would be avoided by implementation of up-to-date provisions for earthquake resistant design and construction. However, Managua did not employ a building code with seismic design requirements appropriate to its earthquake risk, and furthermore, did not have a building regulatory system capable of effective implementation of its building code provisions. This report documents the observations of damages by the NBS/NAE team and points out relationships to inadequacies in the building practices employed. Most of these inadequacies have been well known; however, the Managuan experience may serve as an incentive to improvement of building practices in many other areas which are subject to substantial earthquake risks and have not consistently accounted for these risks in their building codes and building regulatory system.

TN808. **Potential systems for lead hazard elimination: Evaluations and recommendations for use,** D. Waksman, J. B. Ferguson, M. Godette, and T. Reichard, Nat. Bur. Stand. (U.S.), Tech. Note 808, 192 pages (Dec. 1973) $1.95, SD Catalog No. C13.46: 808.

Key words: Abrasion; adhesion; colorfastness; covering; flame spread; flash point; impact resistance; lead paint poisoning; materials; performance; properties; scratch resistance; smoke generation; toxic combustion products; toxicity; washability; water vapor permeance.

The National Bureau of Standards is providing technical support to the Department of Housing and Urban Development which is required by Public Law 91-695 (the Lead Paint Poisoning Prevention Act) to carry out a research program to evaluate and make recommendations regarding technology for the removal of the lead based paint hazard from the Nation's housing.

Potential hazard elimination methods have been identified by means of a survey of available technology. This report describes testing and evaluation methodologies used to determine (1) the suitability for use of a series of removal and lead barrier systems, (2) the results of this evaluation, and (3) recommendations concerning the use of said systems.

Paint removal systems were evaluated in terms of the hazards that they present in the course of their use. Both the flammability and the toxicity of the solvents found in removers were considered. Covering systems were evaluated for their suitability for use as barrier layers over lead bearing paints in housing. The effectiveness of covering systems in protecting children from leaded paint, their fire hazard properties and functional properties which are related to their serviceability were considered in making this evaluation. The properties of the systems were assessed in terms of minimum acceptable performance levels and recommendations are given for their use in a field evaluation program.

TN810. **Fire incidents involving sleepwear worn by children ages 6-12,** J. A. Slater, Nat. Bur. Stand. (U.S.), Tech. Note 810, 23 pages (Dec. 1973) 50 cents, SD Catalog No. C13.46:810.

Key words: Accidents; burns; children; clothing fires; deaths; FFACTS; fire; flammable fabrics; injury; sleepwear; standards; statistics.

Sleepwear was the first fabric item ignited more frequently than any other item in over 1,900 fire incidents reported to the National Bureau of Standards Flammable Fabrics Accident Case and Testing System (FFACTS). Information acquired since promulgation of the current sleepwear flammability standard protecting children of ages 0-5 indicates a problem of comparable magnitude exists for children of ages 6-12. Of 316 incidents involving non-contaminated sleepwear that was first to ignite, about one-fourth involved children 0-5 years old and one-fourth involved children 6-12 years old. For the 6-12 group, sleepwear ignited first more often than all other garment items combined. Females outnumbered males 4-to-1 in the 6-12 group, due mostly to the involvement of nightgowns and kitchen ranges, the most common ignition source for this age group. Five of the 6-12 year old children died and 52 of 74 victims were hospitalized. Almost all of the first-to-ignite sleepwear in this group was cotton. Data from Shriners Burns Institute and the National Burn Information Exchange provide further evidence of the involvement of children ages 6-12 in garment fires. It is recommended that a new standard be issued covering sleepwear sizes 7 through 14 to effectively protect 6-12 year old children.

## 3.13. CONSUMER INFORMATION SERIES

Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

CIS7. **What About Metric?,** L. E. Barbrow, Nat. Bur. Stand. (U.S.), Consum. Inf. Ser. 7, 16 pages (Oct. 1973) 80 cents, SD Catalog No. C13.53:7.

Key words: Metric system; SI; weights and measures.

The metric system of measurement, how it compares with our customary system, and how it will affect everyday life are described in everyday terms. Examples of computations of the type frequently encountered by the average citizen are included to illustrate the relative simplicity of the metric system. Although extensive use of the metric system in the United States is envisioned to be several years in the future, the reasons for at least becoming acquainted with the system now are discussed. The necessary acquaintanceship for everyday life involves the learning of fewer than ten metric units of measurement.

# 3.14. NBS INTERAGENCY REPORTS

A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution by the National Technical Information Service (NTIS), Springfield, Va. 22151, in paper copy or microfiche form. The five-digit number in brackets at the end of each item refers to a more complete citation, including the abstract and key words, beginning on pp. 73. This series MUST be ordered from NTIS by the "COM, PB, or AD" number listed at the end of each entry as follows:

NBSIR 73–101. Penetration Resistance Tests of Reinforced Concrete Barriers, R. T. Moore, 83 pages (December 1972). Order from NTIS as COM 73–10867. [See 13384 for abstract.]

NBSIR 73–102. Energy Conservation Through Effective Utilization, C. A. Berg, 53 pages (February 1973). Order from NTIS as COM 73–10856. [See 13385 for abstract.]

NBSIR 73–105. Environmental Evaluation of Polyurethane Foam Core Sandwich Panel Construction, J. R. Shaver, L. W. Masters, T. W. Reichard, and J. H. Pielert, 47 pages (December 1972). Order from NTIS as PB 219–118. [See 13386 for abstract.]

NBSIR 73–110. City I Player's Manual, J. E. Moriarty, 149 pages (March 1973). Order from NTIS as COM 73–11191. [See 13511 for abstract.]

NBSIR 73–116. Study of the Local Resistance of Conventional Plywood Subflooring to Concentrated Load, F. Y. Yokel, 64 pages (March 26, 1973). Order from NTIS as PB 220–432. [See 13388 for abstract.]

NBSIR 73–119. Laser Damage in Materials, A. Feldman, D. Horowitz, and R. M. Waxler, 52 pages (February 1973). Order from NTIS as AD 75–789. [See 13529 for abstract.]

NBSIR 73–121. Structural Tests of a Wood Framed Housing Module, C. W. Yancey and N. F. Somes, 111 pages (March 26, 1973). Order from NTIS as COM 73–10860. [See 13389 for abstract.]

NBSIR 73–125. Interlaboratory Evaluation of the Tunnel Test (ASTM E 84) Applied to Floor Coverings, T. G. Lee and C. Huggett, 56 pages (March 1973). Order from NTIS as COM 73–11189. [See 13530 for abstract.]

NBSIR 73–126. Structural Tests of Mechanical Connections for Concrete Panels, L. E. Cattaneo and F. Y. Yokel, 118 pages (November 1972). Order from NTIS as PB 219–124. [See 13390 for abstract.]

NBSIR 73–127. Evaluation of Lead Paint Hazard Elimination Methods Part II, D. Waksman, L. F. Skoda, E. J. Clark, M. Godettee, 77 pages (March 1973). Order from NTIS as PB 213–352. [See 13391 for abstract.]

NBSIR 73–128. Resistivity and Carrier Lifetime in Gold-Doped Silicon, W. R. Thurber, D. C. Lewis, and W. M. Bullis, 56 pages (January 31, 1973). Order from NTIS as AD 760–150. [See 13419 for abstract.]

NBSIR 73–129. Evaluation of GRP Rod and Rope Materials and Associated End Fittings, N. Halsey, R. A. Mitchell, and L. Mordfin, 87 pages (December 1972). Order from NTIS as AD 759–913. [See 13392 for abstract.]

NBSIR 73–131. Human Factors Evaluation of a Voice Encoding System, V. J. Pezoldt and J. J. Persensky, 51 pages (March 1973). Order from NTIS as COM 73–10863. [See 13393 for abstract.]

NBSIR 73–132. State of the Art on Durability Testing of Building Components and Materials, L. W. Masters, W. C. Wolfe, W. J. Rossiter, Jr., and J. R. Shaver, 128 pages (March 1973). Order from NTIS as PB 222–300. [See 13637 for abstract.]

NBSIR 73–135. Fire Endurance Tests of Steel Sandwich Panel Exterior Wall and Roof/Ceiling Constructions, B. C. Son, 38 pages (December 1972). Order from NTIS as PB 221–310. [See 13394 for abstract.]

NBSIR 73–138. Time Series Forecasting of Highway Accident Fatalities, A. R. Craw, 37 pages (March 1973). Order from NTIS as COM 73–10868. [See 13395 for abstract.]

NBSIR 73–140. Fire Endurance Test of Plywood-Faced Exterior Walls for Single Family Housing, B. C. Son, 24 pages (March 1973). Order from NTIS as PB 220–226. [See 13396 for abstract.]

NBSIR 73–141. Fire Endurance Tests of Plywood on Steel Joist Floor Assemblies, With and Without Ceiling, H. Shoub and B. C. Son, 35 pages (March 1973). Order from NTIS as PB 220–430. [See 13397 for abstract.]

NBSIR 73–144. Climatological Data at the Proposed Prototype Sites in the United States for the Evaluation of HUD Operation BREAKTHROUGH Housing Systems, T. Kusuda, 136 pages (April 10, 1973). Order from NTIS as PB 220–849. [See 13398 for abstract.]

NBSIR 73–146. Outdoor Performance of Plastics X. Final Update of Weathering Data, W. J. Rossiter, Jr., 113 pages (March 1973). Order from NTIS as COM 73–10989. [See 13399 for abstract.]

NBSIR 73–148. Evaluation of the Column Connections Used in a Precast Concrete Modular Housing System, F. Y. Yokel and T. W. Reichard, 90 pages (March 26, 1973). Order from NTIS as PB 220–366. [See 13401 for abstract].

NBSIR 73–151. On Uncertainty in Mass Measurement, J. R. Donaldson, 10 pages (March 1973). Order from NTIS as COM 73–10866. [See 13402 for abstract.]

NBSIR 73–154. A Summary of the Relationships Between Accident Indices and Rates Following a Redefinition of "Failure", A. R. Craw, 17 pages (March 1973). Order from NTIS as COM 73–10865. [See 13403 for abstract.]

NBSIR 73–156. A Study of the Strength Capabilities of Children Ages Two Through Six, W. C. Brown and C. J. Buchanan, 56 pages (August 7, 1973). Order from NTIS as COM 73–11286. [See 13595 for abstract.]

NBSIR 73–157. National Program of Metrology for Ecuador, T. M. Stabler, 33 pages (April 1973). Order from NTIS as COM 74–10394. [See 13777 for abstract.]

NBSIR 73–159. U.S. Membership in the International Organization of Legal Metrology, T. M. Stabler, 12 pages (April 1973). Order from NTIS as COM 73–11174. [See 13454 for abstract.]

NBSIR 73–161. Field Test of Hydraulic Performance of a Single-Stack Drainage System at the Operation BREAKTHROUGH Prototype Site in King County, Washington, R. S. Wyly and D. E. Rorrer, 66 pages (May 1973). Order from NTIS as PB 225–310. [See 13778 for abstract.]

NBSIR 73–162. Executive Summary of a Proficiency Test Assessment of Clinical Laboratory Capability in the United States, P. W. Finkel and T. R. Miller, 9 pages (May 1973). Superseded by NBSIR 73–162. Order from NTIS as COM 74–10542. [See 13404 for abstract.]

NBSIR 73–163. A Proficiency Test Assessment of Clinical Laboratory Capability in the United States, P. W. Finkel and T. R. Miller, 114 pages (May 1973). Supersedes NTIS Nos. COM 73–11190 and COM 73–11193. Order from NTIS as COM 74–10542. [See 13779 for abstract.]

NBSIR 73–164. Fire Endurance Test of a Steel Sandwich Panel Floor Construction, B. C. Son, 25 pages (April

1973). Order from NTIS as PB 221–642. [See 13405 for abstract.]

NBSIR 73–165. Fire Endurance Test on a Steel Tubular Column Protected with Gypsum Board, B. C. Son, 23 pages (April 1973). Order from NTIS as PB 221-474. [See 13406 for abstract.]

NBSIR 73–166. Fire Endurance Test of an Interdwelling Double Wall Construction of Paper Honeycomb and Gypsum Board, B. C. Son, 24 pages (April 1973). Order from NTIS as PB 222–297. [See 13407 for abstract.]

NBSIR 73–167. Fire Endurance Test of a Roof/Ceiling Construction of Paper Honeycomb and Gypsum Board, B. C. Son, 20 pages (January 1973). Order from NTIS as PB 222–298. [See 13408 for abstract.]

NBSIR 73–168. Fire Endurance Test of a Fiber Glass Reinforced Polyester Double Wall Assembly, B. C. Son, 26 pages (April 1973). Order from NTIS as PB 221–184. [See 13409 for abstract.]

NBSIR 73–169. Fire Endurance Test of a Wood Stud Interdwelling Double Wall Construction, B. C. Son, 21 pages (April 1973). Order from NTIS as PB 221–185. [See 13410 for abstract.]

NBSIR 73–170. Fire Endurance Test of an Interdwelling Double Wall Constructed of Polyurethane Foam-Filled Sandwich Panels, B. C. Son, 27 pages (April 1973). Order from NTIS as PB 221–193. [See 13411 for abstract.]

NBSIR 73–172. Standardization and Measurement Services in Turkey, H. S. Peiser, R. J. Corruccini, and S. B. Newman, 91 pages (October 14–28, 1972). Order from NTIS as COM 73–11175. [See 13476 for abstract.]

NBSIR 73–173. Fire Endurance Tests of Double Module Walls of Gypsum Board and Steel Studs, B. C. Son, and H. Shoub, 32 pages (April 1973). Order from NTIS as COM 73–10844. [See 13412 for abstract.]

NBSIR 73–175. Estimates of Vehicular Collisions with Multistory Residential Buildings, S. L. Fribush, D. Bowser, and R. Chapman, 72 pages (April 1973). Order from NTIS as COM 74–10395. [See 13781 for abstract.]

NBSIR 73–182. Analyses for Decision in the Office of Flammable Fabrics: The Level of the Standard, A. R. Craw, 80 pages (April 1973). Order from NTIS as COM 73–11284. [See 13596 for abstract.]

NBSIR 73–183. USAC Transferability, D. F. Quigley, 71 pages (April 1973). Order from NTIS as COM 73–11177. [See 13413 for abstract.]

NBSIR 73–184. A Cell Model for Isoperibol Calorimeters, K. L. Churney, E. D. West, and G. T. Armstrong, 100 pages (April 1973). Order from NTIS as COM 73–11110. [See 13474 for abstract.]

NBSIR 73–185. Standardization and Measurement Services in Korea, H. S. Peiser, T. D. Coyle, and R. K. Eby, 41 pages (June 19–30, 1972). Order from NTIS as COM 73–11287. [See 13608 for abstract.]

NBSIR 73–187. The Effect of Impact Loadings on the Performance of Wood Joist Subflooring Systems, H. S. Lew, 49 pages (May 1973). Order from NTIS as PB 221–188. [See 13472 for abstract.]

NBSIR 73–188. Structural Tests on Housing Components of Glass Fiber Reinforced Polyester Laminate, T. W. Reichard, W. E. Greene, Jr., L. E. Cattaneo, and L. W. Masters, 98 pages (April 1973). Order from NTIS as PB 221–183. [See 13473 for abstract.]

NBSIR 73–189. A Comparison of Several Methods for Forecasting U.S. Traffic Fatalities, A. R. Craw, 45 pages (May 1973). Order from NTIS as COM 73–11173. [See 13510 for abstract.]

NBSIR 73–190. Acoustical Evaluation of a Single Family Attached Steel Frame Modular Housing System Constructed on an Operation Breakthrough Prototype Site, T. L. Quindry, 21 pages (April 1973). Order from NTIS as PB 221–189. [See 13414 for abstract.]

NBSIR 73–191. Acoustical Evaluation of a Single Family Attached Wood-Frame Modular Housing System Constructed on an Operation Breakthrough Prototype Site, T. L. Quindry, 21 pages (April 1973). Order from NTIS as PB 221–695. [See 13455 for abstract.]

NBSIR 73–192. Acoustical Evaluation of a Single Family Detached Honeycomb Panel Housing System Constructed on an Operation Breakthrough Prototype Site, T. L. Quindry, 19 pages (April 1973). Order from NTIS as PB 222–231. [See 13415 for abstract.]

NBSIR 73–197, (Revised). Clinical Laboratory Performance Analysis Using Proficiency Test Statistics, P. W. Finkel and J. W. Rowen, 63 pages (December 1973). Order from NTIS as COM 74–10468. [See 13564 for abstract.]

NBSIR 73–198. General Purpose Scientific Document Code Operations Under Exec 8, R. McClenon, 21 pages (May 1973). Order from NTIS as COM 73–11289. [See 13598 for abstract.]

NBSIR 73–201. Composite-Overlay Reinforcement of Cutouts and Cracks in Metal Sheet, R. A. Mitchell, R. M. Woolley, and D. J. Chwirut, 94 pages (February 1973). Order from NTIS as COM 73–11221. [See 13607 for abstract.]

NBSIR 73–203. Chemical Kinetics Data Survey IV. Preliminary Tables of Chemical Data for Modelling of the Stratosphere, D. Garvin, Editor, 97 pages (May 1973). Order from NTIS as COM 73–11288. [See 13597 for abstract.]

NBSIR 73–206. Chemical Kinetics Data Survey V. Sixty-six Contributed Rate and Photochemical Data Evaluations on Ninety-four Reactions, D. Garvin, Editor, 120 pages (May 1973). Order from NTIS as COM 73–11253. [See 13563 for abstract.]

NBSIR 73–207. Chemical Kinetics Data Survey VI: Photochemical and Rate Data for Twelve Gas Phase Reactions of Interest for Atmospheric Chemistry, R. F. Hampson, Editor, 127 pages (August 1973). Order from NTIS as AD 769266. [See 13770 for abstract.]

NBSIR 73–208. Residential Buildings and Gas-Related Explosions, E. F. P. Burnett, N. F. Somes, and E. V. Leyendecker, 32 pages (June 1973). Order from NTIS as COM 74–10127. [See 13782 for abstract.]

NBSIR 73–209. Survey of Various Approaches to the Chemical Analysis of Environmentally Important Materials, B. Greifer and J. K. Taylor, 237 pages (July 1973). Order from NTIS as COM 74–10469. [See 13783 for abstract.]

NBSIR 73–217. Use of Computer Networks in Support of Interactive Graphics for Computer-Aided Design and Engineering, M. D. Abrams, J. A. Hudson, P. Meissner, T. N. Pike, Jr., R. M. Rosenthal, and F. H. Ulmer, 47 pages (June 30, 1972). Order from NTIS as COM 74–10470. [See 13784 for abstract.]

NBSIR 73–218. NEPA and the Environmental Movement: A Brief History, L. G. Llewellyn and C. Peiser, 40 pages (July 1973). Order from NTIS. [See 13785 for abstract.]

NBSIR 73–220. Test of a Polyester Composite Wall Panel for Moisture Accumulation and Potential Removal of Moisture Through Venting, C. I. Siu, W. M. Ellis, and T. Kusuda, 18 pages (May 1973). Order from NTIS as PB 222–437. [See 13610 for abstract.]

NBSIR 73–221. Abnormal Loading on Buildings and Progressive Collapse, N. F. Somes, 76 pages (May 1973). Order from NTIS as PB 220-849. [See 13475 for abstract.]

NBSIR 73–223. Penetration Tests on J-SIIDS Barriers, R. T. Moore, 86 pages (June 4, 1973). Order from NTIS as COM 73–11220. [See 13562 for abstract.]

NBSIR 73-228. Summary of Flame Spread and Smoke Generation Tests Conducted for Operation Breakthrough, J. B. Ferguson, 27 pages (July 1973). Order from NTIS as PB 222–425. [See 13609 for abstract.]

NBSIR 73–231. Response Characteristics of a Portable X-ray Fluorescence Lead Detector: Detection of Lead in Paint, J. C. Spurgeon, 37 pages (June 1973). Order from NTIS as PB 224–645. [See 13766 for abstract.]

NBSIR 73–240. Effects of Electroless Nickel Process Variables on Quality Requirements, F. Ogburn and C. E. Johnson, 34 pages (June 1973). Order from NTIS as COM 74–10986. [See 13786 for abstract.]

NBSIR 73–242. Pilot Demonstration of Lead Based Paint Hazard Elimination Methods, T. H. Boone, T. R. Ray, W. G. Street, 38 pages (June 1973). Order from NTIS as PB 224–654. [See 13767 for abstract.]

NBSIR 73–244. The Role of Passive Film Growth Kinetics and Properties in Stress Corrosion and Crevice Corrosion Susceptibility, J. Kruger and J. R. Ambrose, 75 pages (July 1973). Order from NTIS as AD 767–326. [See 13769 for abstract.]

NBSIR 73–248. A Survey of the Sanitary Conditions of Migrant Labor Camps, C. Fried, R. Ramsburg, and S. Butler, 83 pages (August 1973). Order from NTIS as COM 74–10474. [See 13787 for abstract.]

NBSIR 73–251. Analytical Methods for the Detection of Toxic Elements in Dry Paint Matrices—A Literature Survey, M. Paabo, 49 pages (July 1973). Order from NTIS as PB 224–688. [See 13768 for abstract.]

NBSIR 73–252. MFPG Detection, Diagnosis, and Prognosis, 268 pages (September 1973). Order from NTIS as AD–772082. [See 13789 for abstract.]

NBSIR 73–263. Fire Endurance Tests of Unprotected Wood-Floor Constructions for Single-Family Residences, B. C. Son, 65 pages (July 1973). Order from NTIS as PB 225–284. [See 13790 for abstract.]

NBSIR 73–265. The Shirley Highway Express-Bus-On-Freeway Demonstration Project-Users' Reactions to Innovative Bus Features, T. H. Saks, R. F. Yates, and K. M. Goodman, 53 pages (June 1973). Order from NTIS as COM 73–11453. [See 13644 for abstract.]

NBSIR 73–266. Fire Spread on Exterior Walls Due to Flames Emerging from a Window in Close Proximity to a Reentrant Wall Corner, B. C. Son and J. B. Fang, 35 pages (April 1973). Order from NTIS as PB 225–286. [See 13791 for abstract.]

NBSIR 73–267. Report of Fire Tests on Flexible Connectors in HVAC Systems, L. A. Issen, 67 pages (July 1973). Order from NTIS as COM 73–11955. [See 13792 for abstract.]

NBSIR 73–268. Laser Damage in Materials, A. Feldman, D. Horowitz, and R. M. Waxler, 44 pages (August 1973). Order from NTIS as AD 768–303. [See 13793 for abstract.]

NBSIR 73–275. Report to AID on an NBS/AID Workshop on Standardization and Measurement Services in Industrializing Economics, M. B. McNeil, 64 pages (September 1973). Order from NTIS as COM 74–10126. [See 13794 for abstract.]

NBSIR 73–277. Evaluation of a Pressurized Stairwell Smoke Control System for a 12 Story Apartment Building, F. C. W. Fung, 53 pages (June 1973). Order from NTIS as PB 225–278. [See 13795 for abstract.]

NBSIR 73–288. Swiss Building and Housing Research Activities, H. R. Trechsel, 63 pages (August 1973). Order from NTIS as COM 73–11861. [See 13796 for abstract.]

NBSIR 73–289. Characterization and Testing of Interactive Graphics for Computer-Aided Design and Engineering, S. Treu, 36 pages (June 30, 1973). Order from NTIS as COM 74–10475. [See 13797 for abstract.]

NBSIR 73–295. Interim Report No. 7. Chemical Resistance and Physical Durability Testing of Coating Materials, J. R. Clifton, H. F. Beeghley, and R. G. Mathey, 22 pages (August 1973). Orde rfrom NTIS as COM 74–10471. [See 13798 for abstract.]

NBSIR 73–301. Development of Insulation Transfer-Standards Using a Flat Plate Calorimeter, P. R. Ludtke, 43 pages (March 1973). Order from NTIS as COM 73–10762. [See 13416 for abstract.]

NBSIR 73–302. RF Null Detector NBS/SND, R. E. Stoltenberg, 88 pages (June 1973). Order from NTIS as COM 73–10869. [See 13420 for abstract.]

NBSIR 73–303. Fast Fourier Transform Implementation for the Calculation of Network Frequency Domain Transfer Functions from Time Domain Waveforms, W. L. Gans and N. S. Nahman, 53 pages (December 1972). Order from NTIS as AD 759–374. [See 13417 for abstract.]

NBSIR 73–308. Insulation of Liquid Oxygen Dewars, C. F. Sindt, 44 pages (April 1973). Order from NTIS as AD 763–325. [See 13418 for abstract.]

NBSIR 73–309. Random Sampling Oscilloscope Time Base, J. R. Andrews, 87 pages (June 1973). Order from NTIS as COM 73–11981. [See 13799 for abstract.]

NBSIR 73–312. Notes on Infrared Absorption Experiments in a Methane Molecular Beam, P. Kartaschoff, S. Jarvis, Jr., 32 pages (May 1973). Order from NTIS as COM 73–11893. [See 13800 for abstract.]

NBSIR 73–318. Mass Quantity Gauging by RF Mode Analysis, R. S. Collier, D. Ellerbruch, J. E. Cruz, R. W. Stokes, P. E. Luft, R. G. Peterson, A. E. Hiester, 183 pages (June 1973). Order from NTIS as N 73–27390. [See 13664 for abstract.]

NBSIR 73–320. Bibliography of the Electromagnetics Division June 30, 1972 to June 30, 1973, M. L. Woolley, 22 pages (June 1973). Order from NTIS as COM 73–11971. [See 13801 for abstract.]

NBSIR 73–322. Forced Convection Heat Transfer to Subcritical Helium I, P. J. Giarrantano, R. C. Hess, M. C. Jones, 45 pages (May 1973). Order from NTIS as AD 766–221. [See 13666 for abstract.]

NBSIR 73–326. Wavelength of a Slotted Rectangular Line Containing Two Dielectrics, H. E. Bussey, 17 pages (July 1973). Order from NTIS as COM 73–11465. [See 13665 for abstract.]

NBSIR 73–338. Calculated Liquid Phase Thermodynamic Properties and Liquid-Vapor Equilibria for Fluorine-Oxygen (FLOX) Mixtures, W. R. Parrish and M. J. Hiza, 28 pages (September 1973). Order from NTIS as COM 73–11660. [See 13803 for abstract.]

# 4. TITLES AND ABSTRACTS OF PAPERS PUBLISHED IN NON-NBS MEDIA, 1973

Reprints from the journals listed in this section may often be obtained from the authors. See page 5 for additional information.

**13058.** Powell, C. J., Mandl, A., **High-resolution measurements of the $L_3M_{2,3}M_{4,5}$ Auger transitions in nickel and copper,** *Phys. Rev. Lett.* **29,** No. 17, 1153-1156 (Oct. 23, 1972).

Key words: Aluminum; Auger transitions; copper; electronic density of states; nickel; secondary-electron energy distribution; x-ray photoemission.

Measurements are reported (with $\approx 0.1$-eV resolution) of the $L_3M_{2,3}M_{4,5}$ Auger-electron energy distributions from evaporated Ni and Cu using electron-beam excitation. The data reveal new structure (over an $\simeq 20$-eV range) that could be correlated in part with the final states (for atomic Cu) and in part with overall features of the 3*d*-band density of states determined by soft-x-ray emission spectroscopy and x-ray photoelectron spectroscopy.

**13059.** Sengers, J. M. H. L., Greer, S. C., **Thermodynamic anomalies near the critical point of steam,** *Int. J. Heat Mass Transfer* **15,** 1865-1886 (1972).

Key words: Coexistence curve; compressibility; critical anomalies; critical exponents; critical region; equation of state; scaling law; specific heat; steam; water.

Ideas about the character of critical anomalies obtained from the lattice gas model are tested on the thermodynamic properties of steam, using methods developed for nonpolar gases. The critical anomalies in steam are shown to be nonclassical and very similar to those of simple gases. Specifically, the exponents obtained by power-law analysis of the coexistence curve, specific heat $C_v$ and compressibility $K_T$ are $\beta = 0.347 \pm 0.005$, $\alpha = 0.1 \pm 0.05$, $\gamma = 1.20 \pm 0.05$, implying $\delta = 4.45$. Since the critical point is thus a point of nonanalyticity in the thermodynamic behavior, the scaled equation of state may be an appropriate means to describe the critical region. Some results of such a scaled analysis of the *PVT* data are presented and shown to be consistent with independently measured vapor pressure and specific heat data and with the exponents quoted. The best value obtained for the critical temperature by scaling is 373.9 °C ± 0.05°, values between 0.322 and 0.327 g/cm³ are obtained for the critical density depending on the property analyzed.

**13060.** Acquista, N., Abramowitz, S., **Infrared spectrum of matrix isolated $NbF_5$,** *J. Chem. Phys.* **56,** No. 11, 5221-5224 (June 1, 1972).

Key words: Infrared spectrum; Knudsen effusion; matrix isolation; molecular structure, $NbF_5$; vibrational assignment.

The infrared spectra of matrix isolated $NbF_5$ as well as some gas phase spectra have been observed. These spectra have been obtained using double boiler Knudsen cells. An interpretation of the spectra to yield the six infrared active frequencies of a $C_{4v}$ monomeric structure for $NbF_5$ is advanced.

**13061.** Wall, L. A., Brown, D. W., **High pressure polymerization of perfluorostyrene,** *J. Fluorine Chem.* **2,** No. 1, 73-85 (1972/73).

Key words: High pressure; perfluorostyrene; polymerization; polyperfluorostyrene.

Perfluorostyrene was prepared by reaction between pentafluorophenyllithium and tetrafluoroethylene and its physical behavior and thermal polymerization were studied in the temperature and pressure ranges 17-155° and 6,800-20,000 atm respectively. When highly superpressed the monomer becomes viscous and often glassy. The polymerization rates range from $10^{-3}$ to more than $10^2$ percent $h^{-1}$. They generally increase with temperature and pressure. Polymer intrinsic viscosities range from 0.07 to 0.41 $dlg^{-1}$. In liquid phase polymerizations they increase with pressure and decrease with temperature. In the glassy phase, polymer of lower intrinsic viscosity is formed; in the crystalline phase, higher polymer is formed.

**13062.** Barnes, J. A., Winkler, G. M. R., **The standards of time and frequency in the U.S.A.,** *Proc. 26th Annual Symp. on Frequency Control, Atlantic City, N.J., June 6-8, 1972,* pp. 269-284 (Electronic Industries Association, Washington, D.C., 1972).

Key words: Astronomical time; atomic time; frequency; international atomic time; management; NBS; standard time; time; USNO.

The National Bureau of Standards (NBS) and the U.S. Naval Observatory (USNO) are the two organizations chiefly involved in distributing accurate and precise time and frequency information within the U.S.A. The NBS is responsible for the "custody, maintenance, and development of the national standards" of frequency and time (interval) as well as their dissemination to the general public. The mission of the USNO includes the "provision of accurate time" as an integral part of its work concerned with the publication of ephemerides in support of navigation and in the establishment of a fundamental reference system in space.

Both agencies provide the U.S. contribution to the Bureau International de l'Heure (BIH) [International Time Bureau], which has the responsibility of publishing definitive values of Universal Time (UT), International Atomic Time (IAT), and Coordinated Universal Time (UTC).

**13063.** Zapf, T. L., **Accuracy and precision,** Chapter 4 in *Basic Electronic Instrument Handbook,* C. F. Coombs, Jr., Ed., pp. 4-1 – 4-20 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: Accuracy; error analysis; instrument errors; measurement errors; precision.

Topics in this chapter have been chosen to give the reader a basic understanding of many of the concepts, procedures, and mathematical tools used by metrologists to ascertain the accuracy and the precision of measurements. The chapter includes discussions of errors, corrections, precision, accuracy, systematic and random errors, statistical methods, measures of imprecision, computations based on samples, errors in the use of instruments, and scale-reading errors. Basic information for the treatment of errors in measurements, and in instruments, is given.

**13064.** Howe, D. A., **Nationwide precise time and frequency distribution utilizing an active code within network television broadcasts,** (Proc. 26th Annual Frequency Control Symp., Atlantic City, N.J., June 6-8, 1972, Electronic Industries Association, Washington, D.C., 1972) *IEEE Trans. Instr. Meas.* **IM-21,** No. 3, 263-276 (Aug. 1972).

Key words: Frequency standard; network path delay; stability; time and frequency dissemination; time code generator; time code receiver.

Because of the increasing interest in time and frequency dissemination via television signals, the National Bureau of Standards (NBS) has sponsored an experiment using an active time and frequency code transmitted on a U.S. television network encompassing nationwide coverage. Some history of the project is given. The format of the television code and the equipment necessary to generate and decode the transmitted information are discussed. Statistical results of system stability from New York City, N.Y., to Boulder, Colo., and to Los Angeles, Calif., are presented, and comparisons are made with earlier observations using the passive line-10 television time synchronization technique and the 3.58-MHz color-burst frequency reference used for colorcasts. Analysis of the frequency-transfer capability is presented, and the ability of a phase-locked oscillator to lock to the code's frequency reference is discussed. With the decoder's oscillator in a locked condition, plots of phase with respect to time, time domain stability using the Allan variance, and spectral noise reveal that the system permits calibration of a remote standard to one part in $10^{11}$ within one-half hour. Long-term stability (several days) is typically a few parts in $10^{12}$. Using an active time code, short-term stability is governed to a noticeable degree by the television industry's standard video format. Finally, a schematic diagram, with discussion, outlines how time-of-day information can be extracted from the television code used in this experiment.

**13065.** Faller, J. E., Bender, P. L., Alley, C. O., Currie, D. G., Dicke, R. H., Kaula, W. M., MacDonald, G. J. F., Mulholland, J. D., Plotkin, H. H., Silverberg, E. C., Wilkinson, D. T., **Geodesy results obtained with lunar retroreflectors,** S. W. Henriksen, A. Mancini, and B. H. Chovitz, Eds., (Proc. Symp. on the Use of Artificial Satellites for Geodesy, Washington, D.C., Apr. 1971), Paper 6, Extraterrestrial Geodesy in *Geophys. Mongr. Series* **15**, 261-264 (American Geophysical Union, Washington, D.C., 1972).

Key words: Earth rotation; geodesy; laser distance measurements; lunar range; polar motion.

Retroreflector packages have been carried to the moon by the Apollo 11, Apollo 14, and Apollo 15 missions, as well as by Luna 17. Laser ranging from the earth onto these packages should eventually yield information on polar motions and crustal movements accurate to a few centimeters, and on UT1 to 100 $\mu$sec. Present (1971) error of the range measurements is 30 cm, but accuracy to 3 cm should be obtainable with improvements in methods and equipment.

**13066.** Johnson, D. R., Lovas, F. J., **Microwave detection of the molecular transient methyleneimine ($CH_2=NH$),** *Chem. Phys. Lett.* **15,** No. 1, 65-68 (July 15, 1972).

Key words: Methyleneimine; microwave spectrum; pyrolysis; quadrupole structure; rotational transitions; transient species.

The molecular transient methyleneimine ($CH_2=NH$) has been identified in the gas phase from its microwave spectrum. Preliminary analysis of the rotational spectrum of $^{12}CH_2=^{14}NH$ shows the molecule to be planar with rotational constants (in MHz) of $A=196\,211$, $B=34\,642$, and $C=29\,352$. Estimates of the nuclear quadrupole coupling constants and electric dipole moment for the molecule are given. The half-life of this transient molecule is estimated to be less than 0.1 sec under the conditions used in the experiment under discussion.

**13067.** Geist, J., **Waveform-independent lock-in detection,** *Rev. Sci. Instrum.* **43,** No. 11, 1704-1705 (Nov. 1972).

Key words: Lock-in detection; synchronously rectified detection.

A modification of the commonly used lock-in detection technique is proposed. This technique produces an output signal that is independent of the waveform of the input signal.

**13068.** Mizushima, M., Wells, J. S., Evenson, K. M., Welch, W. M., **Laser magnetic resonance of the $O_2$ molecule using the 337-$\mu$m HCN laser,** *Phys. Rev. Lett.* **29,** No. 13, 831-833 (Sept. 25, 1972).

Key words: HCN laser; laser magnetic resonance; molecular constants of $O_2$; $O_2$ spectrum.

We observed thirteen laser magnetic resonance lines (transitions between $[n=3, J=4]\rightarrow[n=5, J=5]$) for the oxygen molecule, using the 337-$\mu$m line of the HCN laser. The magnetic $g$ factors ($g_\perp=2.0044$, $g_z=2.0020$, and $g_n=0.000\,125$) give the best fit to the data. The zero-field frequency for the transition ($N=J=3)\rightarrow(N=J=5$) obtained by using these sets of the magnetic $g$ factors all agree with theoretical value of $775.700\,43\pm 0.000\,01$ GHz if an experimental uncertainty of $\pm 1$ G ($\pm 10^{-4}$ T) is allowed.

**13069.** Wells, J. S., Evenson, K. M., Day, G. W., Halford, D., **Role of infrared frequency synthesis in metrology,** *Proc. IEEE Letters* **60,** No. 5, 621-623 (May 1972).

Key words: Frequency metrology; frequency of lasers; infrared frequency synthesis; laser frequency stabilization; methane-stabilized He-Ne laser; speed of light.

Infrared frequency synthesis (IFS) techniques are briefly surveyed, and some important results are summarized. The recent measurement of the frequency of the methane-stabilized He-Ne laser is significant due to the accurate measurement of the methane wavelength and its fundamental role in metrology. The possibilities of an improved value for the speed of light and of additional applications for frequency measurements at various levels of accuracy are discussed.

**13070.** Howe, D. A., **Results of active line-1 TV timing,** *Proc. IEEE Letters* **60,** No. 5, 634-637 (May 1972).

Key words: Frequency standard; network path delay; stability; time and frequency dissemination; time code generator; time code receiver.

Because of the increasing interest in time and frequency dissemination via television signals, NBS has sponsored an experiment using an active time and frequency code transmitted on a U.S. television network encompassing nationwide coverage. The code format is discussed and statistical results of system stability using the network path from New York City, N.Y., to Boulder, Colo., are presented through plots of phase with respect to time and plots of time domain stability using the Allan variance. Comparison is made of the frequency transfer capability of the line-1 method to the 3.57954...MHz color subcarrier signal used for network colorcasts. The active line-1 TV time system offers distinct advantages over existing dissemination methods utilized within the continental U.S. of principal interest is the short measurement period required for a time or frequency calibration. The system typically permits calibration of a remote standard to 1 part in $10^{11}$ within one-half hour.

**13071.** Phillips, W. E., **Interpretation of steady-state surface photovoltage measurements in epitaxial semiconductor layers,** *Solid-State Electron.* **15,** No. 10-E, 1097-1102 (Oct. 1972).

Key words: Absorption coefficients; epitaxial silicon; minority carrier diffusion length; minority carrier lifetime; semiconductor characterization; surface voltage.

Analysis of the steady-state surface photovoltage (SPV) method of measuring minority carrier diffusion length ($L$) has been extended to the case of an epitaxial layer on a thick substrate. In layers with thickness greater than four diffusion lengths, the measurement yields the bulk value of $L$. For layers thinner than $0.5L$, the measured value is that of the substrate. For intermediate thickness, the bulk value of $L$ can be estimated. The method also provides a sensitive means of observing the influence of surface conditions on the absorption characteristics of silicon.

**13072.** Arp, V., **Forced flow, single-phase helium cooling systems,** Chapter on Helium Heat Transfer in *Advances in Cryogenic Engineering.* A Collection of Invited Papers presented at National Technical Meetings during 1970 and 1971, **17,** Paper J-4, 342-351 (Plenum Press, Inc., New York, N.Y., 1972).

Key words: Forced flow; heat transfer; helium; refrigeration.

A flow loop using pumped supercritical helium for transferring heat from a source to a sink is considered. General factors concerning design of the loop are outlined, and pumping losses are considered in some detail. It is concluded that pumping losses depend very sensitively on the heat transfer requirements, and optimization of design must be done carefully for any particular system. Further studies of combined heat transfer and refrigeration cycles are encouraged.

**13073.** Brennan, J. A., Mann, D. B., Dean, J. W., Kneebone, C. H., **Performance of NBS cryogenic flow research facility,** Chapter on Measurement and Instrumentation in *Advances in Cryogenic Engineering.* A Collection of Invited Papers presented at National Technical Meetings during 1970 and 1971, **17,** Paper G-2, 199-205 (Plenum Press, Inc., New York, N.Y., 1972).

Key words: Accuracy statement; cryogenic; flow facility; liquid nitrogen; measurement.

The National Bureau of Standards and the Compressed Gas Association have jointly sponsored a research program on cryogenic flow measurement. A cryogenic flow research facility was constructed and was first used to evaluate commercially available positive displacement cryogenic flowmeters operating with liquid nitrogen.

The performance of the flow facility was simultaneously being evaluated during the meter tests. This is a summary report of the performance evaluation of the flow facility. An accuracy statement is given for both totalized mass and volumetric flow.

**13074.** Broadhurst, M. G., **Use and replaceability of polychlorinated biphenyls,** *Environ. Health Perspect.,* pp. 81-102 (Oct. 1972).

Key words: Dielectric fluids; heat transfer; plasticizers; polychlorinated biphenyl; transformers.

On September 1, 1971, an interdepartmental task force was formed to coordinate the U.S. Government's scientific studies of polychlorinated biphenyl (PCB's). The task force was coordinated by the Office of Science and Technology and the Council on Environmental Quality. Represented on the task force were the following agencies: the Environmental Protection Agency, the Food and Drug Administration, the National Institute of Environmental Health Services, and the Departments of Agriculture, Commerce, Interior, and Justice.

On September 13, individual tasks were assigned to participating agencies, and the Department of Commerce was asked to critically explore the question of the utility and replaceability of PCB's. Dr. Robert W. Cairns, Deputy Assistant Secretary of Commerce for Science and Technology, requested NBS to assist him in this task.

This study has included consideration of the uses and replaceability of PCB's in the following areas: (1) Dielectric fluids for capacitors and transformers; (2) Industrial fluids for hydraulic, gas turbine, and vacuum pump uses; (3) Heat transfer fluids; and (4) Plasticizers and miscellaneous uses.

**13075.** Suzuki, G., **Measurements and nuclear accountability methods,** *Proc. AEC Symp. on Safeguards Research and Development, Los Alamos, N. Mex., Oct. 27-29, 1969,* pp. 67-68 (Mar. 1970).

Key words: Nuclear material balance accountability; nuclear material control; nuclear safeguards.

The problem discussed is the need for better material accountability through the application of better measurements in nuclear safeguards. This paper points out that accountability has many aspects and compares two of them. One aspect is that accountability is considered in the sense of a tighter material balance, accomplished by more accurate measurements in material accounts of inputs, outputs, and in inventory. Although the material balance for a process or, if you will, the entire plant is a necessary tool in nuclear materials accountability, its usefulness is limited to an indication that there is an unaccounted for loss but such loss is not necessarily due to diversion of material or to an unusual situation. Since the material balance is an aggregative tool dealing with totals, it generally does not provide a clue as to whether the material unaccounted for is in one lump or in small pieces or some intermediate form. Another aspect is that accountability be considered in the same sense except that it be accomplished by maintaining material balances around subprocesses, thus serving the additional function of material control. It points out that material control data are important especially in areas where process losses are suspected. In this manner, the safeguards capability of a plant would be enhanced both from the safeguards and plant material control points of view.

**13076.** Huie, R. E., Herron, J. T., Davis, D. D., **Rates of reaction of atomic oxygen with $C_2H_3F$, $C_2H_3Cl$, $C_2H_3Br$, 1,1-$C_2H_2F_2$, and 1,2-$C_2H_2F_2$,** *Int. J. Chem. Kinet.* **IV,** 521-527 (1972).

Key words: Atomic oxygen; haloethylenes; kinetics.

Rate constants for the reactions of atomic oxygen ($O^3P$) with $C_2H_3F$, $C_2H_3Cl$, $C_2H_3Br$, 1,1-$C_2H_2F_2$, and 1,2-$C_2H_2F_2$ have been measured at 307 K using a discharge-flow system coupled to a mass spectrometer. The rate constants for these reactions are (in units of $10^{11}$ cm$^3$ mole$^{-1}$s$^{-1}$) $2.63 \pm 0.38$, $5.22 \pm 0.24$, $4.90 \pm 0.34$, $2.19 \pm 0.18$, and $2.70 \pm 0.34$, respectively. For some of these reactions, the product carbonyl halides were identified.

**13077.** Huie, R. E., Herron, J. T., Davis, D. D., **Absolute rate constants for the reaction $O + O_2 + M \rightarrow O_3 + M$ over the temperature range 200-346 K,** *J. Phys. Chem.* **76,** No. 19, 2653-2658 (1972).

Key words: Atomic oxygen; kinetics; oxygen.

Using the technique of flash photolysis-resonance fluorescence, absolute rate constants have been measured for the reaction $O + O_2 + M \rightarrow O_3 + M$. For the case of M = Ar the temperature range covered was 200-346 K, and the total pressure was varied from 50 to 500 torr. Over the indicated temperature range, an Arrhenius plot of the data yielded the expression $k_{Ar} = (6.57 \pm 0.59) \times 10^{-35} \exp[(1014 \pm 46 \text{ cal mol}^{-1})/RT]$ cm$^6$ molecule$^{-2}$ sec$^{-1}$. A comparison of the third-order rate constants for M = He, Ar, and $N_2$ gave the relative efficiencies for these three gases as 0.92:1.0:1.6 at 298 K. At 218 K, the efficiencies of Ar to $N_2$ were in the ratio of 1.0:1.7. The reported rate mea-

surements indicate that the rate of production of stratospheric ozone could be nearly a factor of 2 lower than that estimated from previously reported values of the third-order rate constant.

**13078.** Koidan, W., Hruska, G. R., Pickett, M. A., **Wedge design for National Bureau of Standards anechoic chamber,** *J. Acoust. Soc. Amer.* **52,** No. 4, Part 1, 1071-1076 (1972).

Key words: Anechoic chamber design; plane-wave tubes; wedges.

Design techniques for anechoic room wedges must always be used with caution because of the possibility that a manufacturer may change the properties of the material. This paper describes efforts at the National Bureau of Standards to adapt to relatively new glass wool manufactured in the United States. A "hybrid" wedge designed for a large anechoic chamber at NBS consists of glass wool of two densities: 3 lb/ft$^3$ for the 55-in-long tapered portion and 1.1 lb/ft$^3$ for the 11-in-long base. Experimental evidence indicates that the light-weight material and the 4-in air space behind the wedge, in conjunction with the heavier material, serve to produce a useful resonance absorption. The "cutoff frequency" attained for the 70-in-long structure was about 45 Hz as measured in a 31-ft plane-wave tube. Normal acoustic impedance measurements looking into the wedge from the tip were made for the hybrid wedge and a half-scale model.

**13079.** Kaldor, A., Olson, W. B., Maki, A. G., **Pollution monitor for nitric oxide: A laser device based on the Zeeman modulation of absorption,** *Science* **176,** 508-509 (May 5, 1972).

Key words: Air pollution; infrared spectroscopy; lasers; nitric oxide; Zeeman effect.

The concentration of nitric oxide can be monitored by a new device in which the Zeeman effect is used to shift an absorption line of nitric oxide into coincidence with a laser line of carbon monoxide. The absorption is modulated by a small, oscillating magnetic field. This device is specific for nitric oxide and is not subject to interference from other gases.

**13080.** Hougen, J. T., **On a vibration-rotation Hamiltonian for bimolecular collisions analogous to the Wilson-Howard vibration-rotation Hamiltonian for isolated molecules,** *J. Chem. Phys.* **56,** No. 12, 6245-6250 (June 15, 1972).

Key words: Angular momentum; bimolecular complex; collisions; group theory; molecule-fixed axes; selection rules; vibration-rotation Hamiltonian.

A bimolecular vibration-rotation Hamiltonian is derived which is analogous to the Wilson-Howard vibration-rotation Hamiltonian for isolated molecules. The bimolecular Hamiltonian involves the use of a "complex-fixed" axis system, i.e., a system with one of its axes along the line joining the centers of mass of the two interacting molecules. The bimolecular vibration-rotation Hamiltonian shows some similarities to the diatomic-molecule vibration-rotation-electronic Hamiltonian, the role of the two atoms in the diatomic molecule being played by the two interacting molecules, the role of the internuclear axis by the line joining the molecular centers of mass, and the role of electronic orbital and spin angular momenta by the vibration-rotation angular momenta of the two interacting molecules. The application of permutation-inversion molecular symmetry group ideas to a bimolecular complex is described.

**13081.** Steiner, B., **Photodetachment of $S^-$: Behavior of the cross section above threshold,** Paper in *Sixth International Conference on the Physics of Electronic and Atomic Collisions, Massachusetts Institute of Technology, Cambridge, Mass., July 28-Aug. 2, 1969, Abstracts of Papers, Session C-8,* pp. 535-537 (Massachusetts Institute of Technology Press, Cambridge, Mass., 1969).

Key words: Cross section behavior; electron affinity; negative ion; photodetachment; S.

The cross section for photodetachment of $S^-$ has been measured over the region within 0.5 eV of threshold in a crossed beam experiment. The behavior of the cross section in this range seems to be distinct from that in the immediate vicinity of threshold and cannot be predicted on the basis of known theory.

**13082.** Marlowe, D. E., Steel, J. S., **A fatigue crack initiation detector,** *J. Mater.* **7,** No. 1, 28-31 (Mar. 1972).

Key words: Aircraft; bend tests; bolted joints; bolts; cracking (fracturing); crack initiation; cyclic loads; differentiating circuits; digital to analog converters; failure; fasteners; fatigue (materials); fatigue tests; linear systems; loads (forces); shear; transformers.

An instrument which detects the initiation of a fatigue crack in the head of a bolt, by measuring the change in relative position of the two ends of the double shear test joint at the maximum of the cyclic load as the crack propagates, has been developed. Increases in relative displacement of 0.00002 in. (0.0005 mm) can be reliably detected using the output of a linear variable differential transformer (LVDT). Detection of the initial head fillet crack should be a more reliable fatigue failure criterion and should result in less experimental scatter than catastrophic failure of the bolt. A detailed description of the instrument and examples of its use and performance are given.

**13083.** Ekberg, J. O., Hansen, J. E., Reader, J., **Analysis of the spectrum of six-times-ionized niobium (Nb VII),** *J. Opt. Soc. Amer.* **62,** No. 10, 1139-1142 (Oct. 1972).

Key words: Niobium; spectra; ultraviolet; wavelengths.

The spectrum of Nb VII has been observed in a sliding-spark discharge with a 5-m grazing-incidence spectrograph. The analysis has yielded nearly all levels of the $4p^4 4d$ configuration that can combine with the $4p^5\ ^2P$ ground term. Seven of the eight levels of the $4p^4 5s$ configuration given previously by Charles and by Chaghtai were confirmed. A new value was found for the eighth. The $4s^2 4p^4 4d + 4s^2 4p^4 5s + 4s 4p^6$ level structure has been theoretically interpreted, with configuration-interaction effects included. The $4s4p^6\ ^2S_{1/2}$ level was found to have a 22% $4s^2 4p^4(^1D)4d^2S$ character and the $4s^2 4p^4(^1D)4d^2S_{1/2}$ level a 20% $4s4p^6\ ^2S$ character. The energy parameters determined by a least-squares fit to the observed level values are compared with Hartree-Fock (HF) calculations. The ionization energy is estimated to be $118.9 \pm 0.7$ eV.

**13084.** Ekberg, J. O., Hansen, J. E., Reader, J., **Analysis of the spectrum of five-times-ionized zirconium (Zr VI),** *J. Opt. Soc. Amer.* **62,** No. 10, 1134-1139 (Oct. 1972).

Key words: Spectra; ultraviolet; wavelengths; zirconium.

The spectrum of Zr VI has been observed in a sliding-spark discharge with a 5-m grazing-incidence spectrograph. The analysis has yielded nearly all levels of the $4p^4 4d$ configuration that can combine with the $4p^5\ ^2P$ ground term. All of the $4p^4 5s$ levels as given by Chaghtai were confirmed. The $4s^2 4p^4 4d + 4s^2 4p^4 5s + 4s 4p^6$ level structure has been theoretically interpreted, with configuration-interaction effects included. The $4s4p^6\ ^2S_{1/2}$ level was found to have a 24% $4s^2 4p^4(^1D)4d^2S$ character and the $4s^2 4p^4(^1D)4d^2S_{1/2}$ level a 21% $4s4p^6\ ^2S$ character. The energy parameters determined from a least-squares fit to the observed level values are compared with Hartree-Fock (HF) calculations. The ionization energy is estimated to be $95.8 \pm 0.6$ eV.

**13085.** Ekberg, J. O., Hansen, J. E., Reader, J., **Analysis of the spectrum of seven-times-ionized molybdenum (Mo VIII) and**

**isoelectronic comparison of the spectra Y V–Mo VIII,** *J. Opt. Soc. Amer.* **62,** No. 10, 1143-1148 (Oct. 1972).

Key words: Molybdenum; spectra; ultraviolet; wavelengths.

The spectrum of Mo VIII has been observed in a sliding-spark discharge with a 5-m grazing-incidence spectrograph. The analysis has yielded nearly all levels of the $4p^4 4d$ configuration that can combine with the $4p^5\ ^2P$ ground term. Six of the eight levels of the $4p^4 5s$ configuration given previously by Charles and by Chaghtai were confirmed. New values were found for the remaining two. The $4s^2 4p^4 4d + 4s^2 4p^4 5s + 4s 4p^6$ level structure has been theoretically interpreted, with configuration-interaction effects included. The $4s4p^6\ ^2S_{1/2}$ level was found to have a 21% $4s^2 4p^4(^1D)4d^2S$ character and the $4s^2 4p^4(^1D)4d^2S_{1/2}$ level a 19% $4s4p^6\ ^2S$ character. The energy parameters determined by a least-squares fit to the observed level values are compared with Hartree-Fock (HF) calculations. The ionization energy is estimated to be $144.0 \pm 1.0$ eV. Isoelectronic comparisons for the level positions in Y V, Zr VI, Nb VII, and Mo V are given graphically. The ratios of the fitted energy parameters to the HF values are compared for these ions.

**13086.** Chesler, S. N., Cram, S. P., **Digitization errors in the measurement of statistical moments of chromatographic peaks,** *Anal. Chem.* **44,** No. 13, 2240-2243 (Nov. 1972).

Key words: Chromatography; statistical moments.

Minimum error curves are calculated for measuring statistical moments of Gaussian and asymmetrical chromatographic peaks which include the effects introduced by analog-to-digital converters and the effect of locating the limits of integration.

**13087.** Holt, H. K., **Theory of laser saturation spectroscopy,** *Phys. Rev. Lett.* **29,** No. 17, 1138-1140 (Oct. 23, 1972).

Key words: Laser; saturated absorption; spectroscopy.

A theory of the laser saturation spectroscopy experiments of Hänsch et al. is presented which is applicable at high values of the saturating laser beam. Phase- and velocity-changing collisions are taken into account.

**13088.** Kuehner, E. C., Alvarez, R., Paulsen, P. J., Murphy, T. J., **Production and analysis of special high-purity acids purified by sub-boiling distillation,** *Anal. Chem.* **44,** No. 12, 2050-2056 (Oct. 1972).

Key words: Distillation; isotope dilution; pure reagents; spark source mass spectrometry; sub-boiling; trace elements.

Sub-boiling distillation from pure quartz or Teflon (Du Pont) stills has been investigated for the production of high-purity inorganic acids and water. Nitric, hydrochloric, hydrofluoric, perchloric, and sulfuric acids produced by this method contained significantly lower cationic impurities than high-purity acids from commercial sources. A complete system, including the Class 100 environment, production, and storage of these high-purity reagents is described. A method based on spark source mass spectrographic isotope dilution analysis has been developed for the simultaneous determination of 17 elements in these materials. Results of the analyses of both the acids purified by sub-boiling distillation and the ACS reagent grade acids used as starting materials are reported. The sum of the common impurity elements determined in the purified acids ranged from 2.3 ppb in nitric acid to 27 ppb in sulfuric acid. No element in any of the purified acids exceeded 10 ppb and most were well below the 1-ppb level.

**13089.** Moore, L. J., Machlan, L. A., **High accuracy determination of calcium in blood serum by isotope dilution mass spectrometry,** *Anal. Chem.* **44,** No. 14, 2291-2296 (Dec. 1972).

Key words: Calcium; isotopes; mass spectrometry; serum.

An isotope dilution technique utilizing thermal ionization mass spectrometry has been developed for the accurate determination of calcium in synthetic and serum samples at the 100 $\mu$g/g level. Calcium was separated from a serum matrix by destruction of the organic matter with $HClO_4$ and $HNO_3$ followed by ion-exchange separation from interferences using AG 50W-X8 100-200 mesh resin. A mass spectrometric isotopic analysis procedure was developed using a $Ca(NO_3)_2$ solution deposited on Re sample filaments in a triple filament thermal ion source. The relative error between calculated and experimentally determined concentrations in synthetic calcium solutions was $\leqq \sim 0.1\%$. The 95% limit of error for a single analysis was $\sim 0.2\%$ for synthetic and serum samples. A comparison of the isotope dilution data with concurrently determined atomic absorption data from several clinical and independent laboratories is presented.

**13090.** Barnes, I. L., Carpenter, B. S., Garner, E. L., Gramlich, J. W., Kuehner, E. C., Machlan, L. A., Maienthal, E. J., Moody, J. R., Moore, L. J., Murphy, T. J., Paulsen, P. J., Sappenfield, K. M., Shields, W. R., **Isotopic abundance ratios and concentrations of selected elements in Apollo 14 samples,** (Proc. 3d Lunar Science Conference, Houston, Tex., Jan. 1972), Supplement 3, *Geochimica et Cosmochimica Acta* **2,** 1465-1472 (1972).

Key words: Absolute abundance ratios; Apollo 14; isotope dilution analyses; Lunar samples; mass spectrometry; relative abundance ratios.

Absolute or relative isotopic abundance ratios have been determined for U, Pb, Rb, Sr, Ca, and Cu on a representative fraction of the bulk fines 14163,159 and for a breccia 14321,221. No significant variations from terrestrial values were noted for the nonradiogenic isotopes. Concentrations were determined for the above elements as well as for Th, B, Ag, Cd, Fe, Ti, and Ni.

$^{207}Pb/^{206}Pb$ ages of about 4860 m.y. (million years) and 4420 m.y. were calculated for 14163 and 14321, respectively. The Pb-U and Pb-Th ages are very slightly discordant, the soils exhibit a reversed discordancy and the breccia a normal discordancy. Extreme inhomogeneity of Rb and Sr in the fines sample was found.

**13091.** Rukwied, A., **High temperature creep cavitation mechanisms in a continuously cast high purity copper,** *Metallurgical Trans.* **3,** 3009-3023 (Nov. 1972).

Key words: Angular distribution of cavities; cavitation; copper; creep; grain boundaries; grain boundary sliding; nucleation of cavities; segregation nodes; vacancy condensation.

Continuously cast high purity copper was used to study intergranular high temperature creep fracture mechanisms. With the help of an internal marker system due to impurity segregation, grain boundary sliding, GBS, was found to have occurred to a similar extent on cavitated and uncavitated boundaries. To explain this phenomenon a void nucleation model involving small nonwetting shearable particles is suggested. Metallographic observations and the apparent activation energy derived from fracture time data indicate the operation of the vacancy condensation mechanism at the lower temperatures and higher stresses. At the higher temperatures and lower stresses void growth is enhanced by GBS. This cavitation mechanism obtains strong support from measurements of the distribution of voids on grain boundaries as a function of the boundary angle with respect to the tensile direction. Computer analysis of these distributions, in terms of a model which properly accounts for the distribution of

potential nuclei, yields bimodal curves exhibiting peaks at grain boundaries oriented for high shear stress (peak I), and for high normal stress (peak II). A phenomenological equation is proposed for the dependence of peak I on test conditions. Peak II is thought to be caused by nucleation by local GBS and growth by vacancy condensation under locally enhanced normal stress.

**13092.** Marzzacco, C. J., Zalewski, E. F., **The fluorescence and phosphorescence spectra of pyrazine in benzene at 4.2 K,** *J. Mol. Spectry.* **43,** No. 2, 239-247 (Aug. 1972).

Key words: Fluorescence; phosphorescence; pyrazine; singlet emission; spectrum of pyrazine in benzene; triplet emission; vibration spectrum.

The fluorescence and phosphorescence spectra of pyrazine-$h_4$ and pyrazine-$d_4$ in benzene at 4.2 K are presented and analyzed. The Frank-Condon patterns of $a_{1g}$ modes in the fluorescence spectrum are quite similar to those in the phosphorescence spectrum for both pyrazine-$h_4$ and pyrazine-$d_4$.

The $\nu_5$ $(b_{2g})$ and $\nu_{10a}$ $(b_{1g})$ out-of-plane bending modes appear with quite different intensities in the fluorescence and phosphorescence spectra. The $0 \rightarrow 1$ transitions in these modes only appear in the fluorescence spectra while the $0 \rightarrow 2$ transitions are more intense in the phosphorescence spectra. These results are interpreted in terms of a vibronic interaction between $^{1,3}B_{3u}$ $(n\pi^*)$ and the $^{1,3}B_{2u}$ $(\pi\pi^*)$ and $^{1,3}B_{1u}$ $(\pi\pi^*)$ states.

No spectroscopic evidence is found for a forbidden $^1n\pi^*$ state below $^1B_{3u}$ $(n\pi^*)$.

**13093.** Reimer, G. M., Wagner, G. A., Carpenter, B. S., **The thermal stability of fission tracks in the Standard Reference Material glass standard (National Bureau of Standards),** *Radiat. Eff. Communication* **15,** 273-274 (1972).

Key words: Fission track; glass; nuclear track technique; Standard Reference Material; thermal stability; uranium.

The relatively low thermal stability of fission tracks in the National Bureau of Standards Standard Reference Material glass indicates that those glasses that are to be used as fission track references should be stored at temperatures below 20 °C. The low track stability may be due to the relatively high sodium and calcium content of the glasses.

**13094.** Ballard, D. B., Bennett, L. H., Swartzendruber, L. J., **Intergranular embrittlement of copper-palladium alloys in salt water,** *Corrosion* **28,** No. 10, 368-373 (Oct. 1972).

Key words: Alloys; copper; corrosion, embrittlement; palladium; salt water.

Intergranular embrittlement occurs when copper-rich Cu-Pd alloys are exposed to an aqueous 3.5 wt% sodium chloride environment. There is no evidence that the embrittlement reaction requires the presence of external or internal stresses for 2, 5, and 15 at% Pd in Cu. Scanning electron microscope (SEM) fractographic observations are reported for as-rolled, vacuum annealed, and hydrogen annealed alloys of composition 95 Cu-5 Pd.

**13095.** Raveché, H. J., Mountain, R. D., **Three atom correlations in liquid neon,** *J. Chem. Phys.* **57,** No. 9, 3987-3992 (Nov. 1, 1972).

Key words: Closure approximation; isothermal/density derivative of pair correlation function; liquid neon; neutron scattering; pair correlation function; triplet correlation function.

We consider the correlation of three atoms in liquid neon from the neutron diffraction measurement of the isothermal density derivative of the pair correlation function. Several closure approximations for the triplet correlation function are discussed. Three of the approximations are representations of the triplet correlation function as a functional of the pair correlation function, and the other is expressed as a simple function of the pair correlation function.

**13096.** Shafer, M. R., Jr., Baker, D. W., **Practical considerations for gas flow measurement,** *Proc. 3d Annual Precision Measurement Association Metrology Conf., National Bureau of Standards, Gaithersburg, Md., June 17-18, 1970,* **1,** 187-227 (Precision Measurements Association, Burbank, Calif., 1970).

Key words: Flowmeter calibration; gas density; gas flow measurement; gas viscosity; mass and volume flow; volumetric proving.

Physical variables and relations encountered in the metering of gases and the calibration of gas flowmeters are reviewed. As modified by the compressibility factor to account for the behavior of real gases, the equation of state is given and the relation between mass and volume rate in steady flow is discussed. Application of these relations to volumetric proving or calibration of meters is explained.

**13097.** Agy, D. L., Nelson, R. E., **An immittance transcomparator,** *Proc. 3d Annual Precision Measurement Association Metrology Conf., National Bureau of Standards, Gaithersburg, Md., June 17-18, 1970,* **1,** 147-154 (Precision Measurements Association, Burbank, Calif., 1970).

Key words: Capacitance; coaxial; high-Q; immittance; inductance; measurement; radio frequency; resonance.

The immittance transcomparator is an instrument which utilizes resonance techniques to make high-Q immittance measurements over the frequency range from 50 MHz to 250 MHz. The basic component of the instrument is a short section of 50 ohm coaxial transmission line with provisions for introducing probes to induce and sample electromagnetic energy. Uncertainties of the order of 0.1% are realizable for the reactive component of the measured immittance.

**13098.** Williams, E. S., **Calibration of thermal voltage converters,** *Proc. 3d Annual Precision Measurement Association Metrology Conf., National Bureau of Standards, Gaithersburg, Md., June 17-18, 1970,* **1,** 131-139 (Precision Measurements Association, Burbank, Calif., 1970).

Key words: Ac-dc transfer; comparator; thermal voltage converter; transfer standard.

Ac-dc difference corrections for thermal voltage converters are obtained by comparing one instrument with another whose corrections are already known. Present methods of making such comparisons are reviewed, and a new TE (thermoelement) comparator is described. This comparator is relatively simple and inexpensive, reduces the effect of power supply instability, and gives accuracies better than 10 parts per million.

**13099.** Hilten, J. S., **Accelerometer calibration with the earth's field dynamic calibrator,** *Proc. 3d Annual Precision Measurement Association Metrology Conf., National Bureau of Standards, Gaithersburg, Md., June 17-18, 1970,* **1,** 27 (Precision Measurements Association, Burbank, Calif., 1970).

Key words: Accelerometer; air bearings; calibrator accelerometer; dynamic; earth's field; Inter-Agency Trans-

ducer Project; low frequency; rotational frequency response; transducer.

This paper describes a simple device for the precise dynamic calibration of certain accelerometers at low frequencies. Calibration of an accelerometer is achieved by rotating the instrument in the earth's gravitational field at a number of constant rotational speeds.

**13100.** Williams, E. R., Olsen, P. T., **A noncontacting magnetic pickup probe for measuring the pitch of a precision solenoid,** (Proc. Conf. Precision Electromagnetic Measurements, National Bureau of Standards, Boulder, Colo., July 1972), *IEEE Trans. Instr. Meas.* **IM-21,** No. 4, 376-379 (Nov. 1972).

Key words: Fine structure constant; fundamental constant; gyromagnetic ratio of proton; NBS ampere; pitch measurement.

The magnetic-field gradients produced by a current sequentially activating a few turns of wire of a precision solenoid are used to measure its pitch. The position of the activated portion of wire can be resolved to 0.1 $\mu$m. Preliminary results are found to be in agreement with an earlier measurement using a contacting probe to within the uncertainty of the latter determination. This new technique reduces many of the difficulties associated with conventional pitch measuring schemes and at the same time provides a method of obtaining increased accuracy.

**13101.** LaVilla, R. E., **The sulfur *K* and *L* and fluorine *K* x-ray emission and absorption spectra of gaseous $SF_6$,** *J. Chem. Phys.* **57,** No. 2, 899-909 (July 15, 1972).

Key words: Molecular orbital model; photon and electron excited emission spectra; resonance radiation; semi-Auger process; $SF_6$; x-ray absorption of sulphur *K*, *L* and fluorine *K*; x-ray emission of sulphur $K\alpha$, $K\beta$, *L* and fluorine $K\alpha$.

With the exception of the sulfur *L*-absorption spectrum, measurements of all the soft x-ray spectra from gaseous $SF_6$ in their respective threshold regions are reported. The valence emission x-ray spectra are interpreted in terms of a molecular orbital model of $SF_6$ with the inclusion of sulfur *d* orbitals. The experimental emission profiles are in fair agreement with a calculated profile based on the assigned orbital ionization energies and molecular orbital theory. The sharp resonance structures in the absorption spectra are found to result from the potential barrier formed by the surrounding fluorine atoms and are consistent with the molecular orbital model. The identification of the absorption resonance structure in terms of transitions to "virtual" unoccupied electronic levels is substantiated by the observation of "resonance radiation," i.e., x-ray emission in coincidence with the peak positions in the absorption region. The sulfur $K\alpha$ spectrum is also presented and discussed. A notable feature in this spectrum is a weak peak on the low energy side of the $K\alpha_{1,2}$ line, which is interpreted as a semi-Auger process.

**13102.** Voth, R. O., **Safety of hydrogen pressure gauges,** Chapter on Safety Considerations in *Advances in Cryogenic Engineering.* A Collection of Invited Papers Presented at National Technical Meetings during 1970 and 1971, **17,** Paper F-2, 182-187 (Plenum Press, Inc., New York, N.Y., 1972).

Key words: Gauge case design; hydrogen embrittlement; hydrogen gas; pressure gauges; safety.

To determine the relative safety of various gauge case designs, thirty-five pressure gauges were purchased and intentionally ruptured using high pressure hydrogen gas. Fire was emitted from nearly all gauges; however, gauges with solid fronts and plastic crystals emitted the fire and debris out the rear of the case making them safer for use in a hydrogen system. One brand of gauge ruptured at reduced pressure when tested with hydrogen. The reduced rupture pressure indicated possible hydrogen embrittlement of the pressure sensing element.

**13103.** Snyder, W. F., **Standards,** Chapter 2 in *Basic Electronic Instrument Handbook,* C. F. Coombs, Jr., Ed., pp. 2-1—2-16 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: Echelon of standards; electrical quantities; environments for standards laboratories; International System derived units; National Bureau of Standards; standards.

Brief accounts are given of the electrical system of units, the International System (SI) of derived units, an echelon of standards, the role of the National Bureau of Standards, and environments for standards laboratories.

**13104.** Snyder, W. F., **Basic electronic standards,** Chapter 3 in *Basic Electronic Instrument Handbook,* C. F. Coombs, Jr., Ed., pp. 3-3—3-64 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: Basic electronic standards; classification of electronic standards; DC standards; low frequency standards; standards (coaxial connectors); standards (waveguide or coaxial line); traceability of electrical standards.

A classification of "atlas" of electronic standards is presented by selection of frequency range, electrical quantity, and an echelon of standards. The reader is referred, by a classification key, to many hundreds of literature sources for detailed information on standards, calibration methods, and measurement techniques.

**13105.** Kelly, G. E., Sengers, J. V., **Collision integrals for the Knudsen number dependence of the growth rate of droplets in supersaturated vapor,** *AEDC-TR-72-172,* 82 pages (Arnold Engineering Development Center, Air Systems Command, Arnold Air Force Station, Tenn., Dec. 1972).

Key words: Growth of droplets; kinetic theory of gases; liquid-vapor phase transitions; mass transport; nucleation theory; phase transitions.

A method is developed for calculating the mass flux to a liquid droplet surrounded by its pure vapor as a function of the Knudsen number. The Knudsen number K is defined as the ratio of the mean free path to the droplet size. When the mass flux is expanded in terms of the inverse Knudsen number $\alpha = K^{-1}$, we obtain a series of the form

$$\Gamma = \Gamma^{(0)} + \Gamma^{(1)}\alpha + \tilde{\Gamma}^{(2)}\alpha^2 \ln\alpha + \ldots .$$

It is shown that the coefficients are determined by integrals associated with sequences of successive collisions among a number of vapor molecules and the droplet. In particular, we derive the collision integrals for the first three coefficients of the inverse Knudsen number expansion for $\Gamma$. These collision integrals bear a close similarity to the collision integrals derived in earlier technical reports for the density dependence of the transport properties of gases. It will be demonstrated in a subsequent technical report that the same method can be used to calculate the aerodynamic force on an object in a gas stream as a function of the Knudsen number.

**13106.** Elbourn, R. D., Saunders, P. B., **Simulation of air traffic control radar beacon code assignment plan 3d1,** *FAA Report No. FAA-RD-72-103,* 56 pages (National Technical Information Service, Springfield, Va. 22151, Sept. 1972).



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Key words: Air traffic control; beacon code assignment; digital simulation; radar beacon system; secondary surveillance radar.

During implementation of the National Airspace System En Route Stage A, some Air Route Traffic Control Centers will have complete radar data processing capability while other centers have only flight plan data processing capability. This report describes a digital computer simulation of three versions of a radar beacon code assignment plan designed for this situation. The simulation employs one peak day's IFR traffic in the U.S.A. It determines the number of codes required, the numbers of code changes in flight for various reasons, and the variation of the number of code conflicts with the number of codes used.

**13107.** Furukawa, G. T., Douglas, T. B., Pearlman, N., **Heat capacities,** Chapter 4e in *American Institute of Physics Handbook, Third Edition,* pp. 4-105—4-118 (McGraw-Hill Book Co., Inc., New York, N.Y., 1972).

Key words: Debye characteristic temperature; Einstein function, Debye function; electronic specific heat; heat capacity; specific heat.

The work presents compilations of specific heats of the elements up to 3000 K, Debye characteristic temperatures and electronic coefficients of specific heat of the elements and some compounds, Einstein functions to five decimals at 0.1 intervals of the argument, and Debye functions to six decimals at 0.1 intervals of the argument. A short bibliography is given.

**13108.** Sengers, J. M. H. L., Klein, M., Gallagher, J. S., **Pressure-volume-temperature relationships of gases; virial coefficients,** Chapter 4i in *American Institute of Physics Handbook, Third Edition,* pp. 4-204—4-221 (McGraw-Hill Book Co., Inc., New York, N.Y., 1972).

Key words: Air constituents; Boyle temperature; deuterium; hydrogen; intermolecular potential; inversion temperature; methane; noble gases; potential parameters; second virial coefficient; third virial coefficient; water vapor.

Tables of second virial coefficients as functions of temperature are presented for 14 gases. These gases are mainly noble gases and constituents of all. In most cases, these are based on a reexamination of the original P-V-T data. Where necessary and possible, these data have been refitted and improved experimental virials determined. In the case of eight of these gases, it has been possible to fit the experimental second virials to those predicted by the ($m$, 6) potential function and potential parameters determined. In almost all cases, an optimum fit was obtained for $m$-18. The optimum potential function was used for extrapolating the tables somewhat beyond the experimental range, and for obtaining temperature derivatives of $B$. In the case of the other six substances virial coefficients predicted by the ($m$, 6) functions were used as a smoothing aid. Experimental third virial coefficients are presented at the experimental temperatures. A table of Boyle and Joule-Thomson inversion temperatures is also presented.

**13109.** Parks, E. J., Hebert, R. L., **Thermal analysis of ion exchange reaction products of wood pulps with calcium and aluminum cations,** *Tappi* **55,** No. 10, 1510-1514 (Oct. 1972).

Key words: Aluminum; calcium; carboxylic acid; cellulose; differential thermal analysis; hemicellulose; ion exchange; pH; pyrolysis; thermal stability; thermogravimetric analysis; wood pulp.

Differential thermal analysis (DTA) and thermogravimetric analysis (TGA) indicate differences in the thermal stability of wood pulps of different compositions. Fourteen typical papermaking pulps having a reported alpha-cellulose content of 85-95% and a carboxyl content ranging from about 2.0 to 9.0 meq/100 g of pulp were purified by deashing with 0.1 $N$ HCl, treated with calcium acetate to provide calcium exchange products and with alum to provide aluminum exchange products. The temperature of an endotherm ($T_3$) and that of the half volatilization temperature ($T_i$) were obtained from DTA and TGA data, respectively. The data indicate that $T_3$ and $T_i$ are directly related to the pH of the various pulps and that pH in turn is a function of the number of carboxylic acid groups. $T_3$ and $T_i$ are consistently lower for pulp-aluminum exchange products and higher for pulp-calcium exchange products than for the corresponding deashed pulps. These trends are interesting because of possible correlations with permanence. Both $H^+$ and $Al^{+++}$ promote volatilization as shown by shifts in $T_i$ to lower temperatures. Calcium retards volatilization, with the result that $T_i$ values are shifted to higher temperatures. The same processes are probably also responsible in part for comparable shifts in $T_3$. There is evidence that hemicelluloses have an important bearing on thermal instability, but this is inconclusive. The concentrations of carboxylic acid groups, which may also be responsible for instability, are closely related to the hemicellulose content of the pulp.

**13110.** Plumb, H. H., Powell, R. L., Hall, W. J., Swindells, J. F., **Temperature scales, thermocouples, and resistance thermometers,** Chapter 4a in *American Institute of Physics Handbook, Third Edition,* pp. 4-2—4-21 (McGraw-Hill Book Co., Inc., New York, N.Y., 1972).

Key words: Electrical resistivity; IPTS-68; temperature scale; thermal emf of elements; thermocouple tables; thermometry; thermometry fixed points.

An abbreviated version of the text of the International Practical Temperature is presented. The article includes the defining fixed points of the scale and the equations that are employed in utilizing standard platinum resistance thermometers, standard thermocouples and optical pyrometers in realizing the temperature scale. A table giving values of temperature differences between IPTS-68 and IPTS-48 is presented. Also included are tables of thermal emf of chemical elements, alloys and thermocouple materials relative to platinum. Thermocouple tables are listed for types S, R, E, J, K and T thermocouples at 10 °C intervals. Finally, the electrical resistivity of some elements and alloys as a function of temperature are given at 100 °C intervals.

**13111.** Enemark, E. A., Gallagher, A., **Electron excitation of the sodium $D$ lines,** *Phys. Rev. A* **6,** No. 1, 192-205 (July 1972).

Key words: Electron excitation; sodium.

The electron excitation of the sodium resonance lines ($D$ lines) has been measured in the energy range from threshold to 1000 eV. The electron-beam full width at half-maximum was ~1/3 eV, and the sodium-beam optical depth was small and varied. After correction for minor cascade contributions and the measured polarization, the excitation function has been normalized to the Born theory in a high-energy limit where the energy dependence converges to the theoretical behavior. The resulting normalized cross section and the polarization are in excellent agreement with recent close-coupling calculations for the energy region from threshold to 5 eV.

**13112.** Roder, H. M., Weber, L. A., Editors, **ASRDI Oxygen Technology Survey: Volume I. Thermophysical Properties,** *NASA Spec. Publ.* **3071,** 434 pages (National Aeronautics and Space Administration, Washington, D.C., 1972).

Key words: Computer programs; gaseous oxygen; graphs; handbook thermophysical properties; liquid oxygen; oxygen; property value uncertainties; solid oxygen; tables.

This Handbook is the result of an extensive survey of the thermophysical properties of oxygen, including densities and the thermodynamic, transport, electrical, optical, and molecular properties for the gaseous and fluid states. A thorough bibliography of published work on each property is given. Recommended references are cited for those properties which have been critically surveyed. Other references are listed which were reviewed but not considered as basic source material. Each property is described and defined; selected values are presented for the more common properties; and, where appropriate, graphical presentation is also made. The major tables cover the range 100-600 °R for pressure to 5000 psia (55-340 K, 340 atmospheres or $345 \times 10^5$ Pa). In addition, for property values beyond this range, recommended references are given, where available. The Handbook is designed to provide a convenient reference for the user.

**13113.** Abrams, M. D., **Data structures for computer graphics,** (Proc. Symp. on Data Structures in Programming Languages, University of Florida, Gainesville, Fla., Feb. 25-27, 1971), *J. Ass. Comput. Mach. SIGPLAN Notes* **6,** No. 2, 268-286 (Feb. 1971).

Key words: Computer graphics; data structures; directed graph.

This paper introduces data structures as applied to computer graphics. Design criteria for computer graphics data structures are discussed, followed by a comparison of general-purpose and tailored graphic data structures. A general graphic data structure is introduced as an example of a structure meeting the preceding criteria. The $L^6$ language is then examined as a tool for implementing the above data structure, and is compared to a few other language systems.

**13114.** Mountain, R. D., **Evaluation of liquid structure data,** *J. Chem. Phys.* **57,** No. 10, 4346-4350 (Nov. 5, 1972).

Key words: Liquid; liquid structure factor; neutron diffraction; pair correlation function; radial distribution function; x-ray diffraction.

A procedure for assessing the overall accuracy of liquid structure factor data is examined. The method makes use of the requirement that the two particle correlation function and its derivative vanish for separations smaller than the size of an atom. A series of numerical experiments, designed to evaluate this procedure, are discussed and a calibration of the method based on these experiments is presented. The method is sensitive when the over-all uncertainties in the data are smaller than 1%. Since this is just the level which is now being achieved in liquid structure measurements, the method should be quite useful in the evaluation of liquid structure data. As an illustration, the method is applied to recently published data for liquid neon and liquid gallium.

**13115.** Laufer, A. H., Okabe, H., **Determination of the heat of formation of diazirine by photon impact,** *J. Phys. Chem.* **76,** No. 23, 3504-3507 (1972).

Key words: Absorption spectrum; diazirine; heat of formation.

Threshold energies of the incident photons required to initiate three primary processes in diazirine (I, II, and III) have been measured yielding 8.6, 7.6, and 11.8 eV, respectively. A lower limit for the heat of formation of diazirine may then be derived, namely, $\Delta H_f^\circ(\text{c-}CH_2N_2) \geq 60.6$ kcal/mol. A probable upper limit of $\Delta H_f^\circ(\text{c-}CH_2N_2) \leq 66$ kcal/mol is obtained from the observation that process I does not occur as a result of Xe (147 nm) photolysis. The difference between the photon impact and previous electron impact value is discussed. The absorption coefficient of diazirine in the region from 125 to 200 nm has been measured.

**13116.** Hudson, R. P., **Very low temperature data. Properties of paramagnetic salts,** Section 5f-15 in *American Institute of Physics Handbook, Third Edition,* pp. 5-224—5-242 (McGraw-Hill Book Co., Inc., New York, N.Y., 1972).

Key words: Low temperatures; paramagnetic salts.

Section 5f-15 of the American Institute of Physics Handbook has been revised and brought up to date.

**13117.** Hils, D., McCusker, M. V., Kleinpoppen, H., Smith, S. J., **Differential and direct differential elastic scattering cross sections for electrons and potassium atoms,** *Phys. Rev. Lett.* **29,** No. 7, 398-401 (Aug. 14, 1972).

Key words: Cross sections; elastic scattering; spin polarization.

In a modulated crossed-beam experiment we have elastically scattered unpolarized electrons of 3.3 eV energy from spin-polarized K atoms. A measurement of the polarization of the scattered electron yields $|f(\theta)|^2/\sigma(\theta)$. Our measured values of $|f|^2/\sigma(\theta)$ show a significant angular shift relative to the theoretical curve in forward-angle scattering ($\theta = 20 - 40°$). This shift is not apparent in measurements of the differential scattering cross section $\sigma(\theta)$ over the same angular range, which, however, do show a significant angular shift in the range $\theta = 50 - 120°$.

**13118.** Saylor, C. P., **Supercooling in the barnyard,** *Chemistry* **45,** No. 11, 19-20 (Dec. 1972).

Key words: Crystallization; notes.

Once a substance has crystallized some molecules may be held on the surface of some invisible foreign particle in a configuration favorable for crystallization. If bonding to the particle is enough, this configuration may persist even above the melting point and serve to reseed the system when it is cooled.

**13119.** Bay, Z., Luther, G. G., White, J. A., **Measurement of an optical frequency and the speed of light,** *Phys. Rev. Lett.* **29,** No. 3, 189-192 (July 17, 1972).

Key words: Optical frequency; single-standard time-length measurement system; speed of light.

We report the measurement of the frequency of the 633-nm red laser line. This is the first measurement of an optical frequency in the visible range without reference to the speed of light or to a measured wavelength. Combination of the optical frequency with the known wavelength yields $c$ to an accuracy higher than previously known. This method demonstrates the practicability of a single-standard time-length measurement system unified via a defined value of the speed of light.

**13120.** Hogben, D., **OMNITAB II: A computing system for statistical problem solving using Dutch rather than FORTRAN or ALGOL,** *Stat. Neerlandica* **26,** No. 3, 85-99 (1972).

Key words: Distribution of first significant digit; Dutch; Graeco-Latin square; language translation; natural language; OMNITAB II computing system; regression; statistical problem solving.

A brief description is given of a new Dutch version of the OMNITAB II computing system. Basic ideas are illustrated in a

simple example. Further details are given in a more sophisticated example in statistical computation. It is suggested that the use of OMNITAB in the user's own language enhances its utility.

13121. Barbrow, L. E., **The metric system and small business,** *Manage. Aids,* No. **214,** 9 pages (Small Business Administration, Washington, D.C., July 1972).

Key words: Foreign trade; harmonization of standards; measurement systems; metric system; U.S. metric study.

From time to time, a Management Aid is published to suggest that owner-managers look to the future—to the horizon. Trends or techniques may be appearing that will demand your attention at a future date. This Aid is such an article. It discusses the matter of the United States changing to the metric system of measurement. At the present time, this country is the only major nation not operating on it or committed to it. The basic material used in developing this Aid is contained in A Metric America—A Decision Whose Time Has Come, which is a Report to the Congress on the findings of a 3-year study on the impact that the increasing worldwide use of the metric system has had on the United States. A plan for national changeover to the metric system over a 10-year period has been recommended. This Aid discusses what led up to that recommendation and urges owner-managers to be alert to developments as the Nation considers this proposal through its Congress.

13122. Barbrow, L. E., **Metrication in the United States, a status report,** *Engineering Issues, Amer. Soc. Civil Eng.* **98,** PP4, 505-510 (Oct. 1972).

Key words: Foreign trade; harmonization of standards; measurement systems; metric system; U.S. metric study.

For 200 years the advantages to America of having an internationally harmonized system of measurements have been reviewed in the Congress. Now the first step in the latest reopening of this subject has been taken in the Congress. No one can predict when the Congress will take final action or what that action will be. However, in view of the increasing use of the metric system not only abroad but in the U.S. also, all sectors of our society should study and determine for themselves whether increasing their metric use would be advantageous and, if so, plan to do so most efficiently. The time may come, sooner or later, when these plans will be welded into a master plan for the Nation. The metric problem has gained top-level consideration; the time to prepare for the future is now.

13123. Branscomb, L. M., **Product performance in an affluent society,** (Proc. 7th Annual Meeting, Symposium and Workshops Arranged by the National Academy of Engineering, Washington, D.C., Apr. 29-30, 1972), Paper in *Product Quality, Performance, and Cost,* pp. 23-31 (1972).

Key words: Conservation; consumer satisfaction; economic design; product safety; standards; test methods.

A detailed discussion is presented of the ecologic, economic, sociological, and political (international as well as local) reasons why more attention must be paid to the way consumer products are designed, built, and promoted, used, repaired, discarded, etc. The paper follows the theme of the public statements of the current administration as regards concern for the consumer. It touches upon the role of standards and test methods—both existing and those still to be developed in protecting the consumer pocketbook, his health and well-being and what is more important the limited natural resources of the earth.

13124. Jesch, R. L., Berry, I. S., **Batteries used with law enforcement communications equipment: Comparison and performance characteristics,** *LESP-RPT-0201.00,* 42 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1972).

Key words: Batteries; battery comparison; communications; law enforcement; performance characteristics.

This report is the result of an extensive literature search conducted in the field of primary and secondary batteries. It lists terms and definitions pertaining to batteries and their characteristics, reviews basic battery principles and types, and assembles performance characteristics of battery systems into chart form for comparative purposes. Considered are recommended batteries, basic precautions and references to pertinent literature.

13125. O'Connell, J. S., Donnelly, T. W., Walecka, J. D., **Semileptonic weak interactions with $C^{12}$,** *Phys. Rev. C* **6,** No. 3, 719-731 (Sept. 1972).

Key words: Beta decay; carbon; electromagnetic; form factor; muon; neutrino; weak interaction.

A unified analysis of semileptonic weak and electromagnetic interactions in nuclei is applied to the $A = 12$ system. The particle-hole model is used to describe the nuclear dynamics of $B^{12}$, $C^{12}$, and $N^{12}$. Neutrino reaction cross sections are presented for comparison with future experiments.

13126. Lehman, D. R., **Quasifree proton-proton and proton-deuteron scattering on $^3$He,** *Phys. Rev. C* **6,** No. 6, 2023-2031 (Dec. 1972).

Key words: Pole dominance; quasifree scattering; rescattering effects; separable potentials; three-body problem; $^3$He.

Quasifree proton scattering from $^3$He is examined on the basis of available data. Cross sections are given in the pole-dominance approximation for either two protons or a proton and deuteron detected in coincidence. The cross sections are evaluated for a constant $^3$He vertex and a separable-potential model of the $^3$He vertex amplitude. Both two- and three-body breakup of $^3$He are considered, with final-state rescattering included between the spectator nucleons in three-body breakup. It is shown that the asymptotic form of the coordinate-space $^3$He wave function governs the shape of these low-momentum-transfer cross sections and that final-state rescattering between the spectator pair in $^3$He$(p, 2p)pn$ mainly affects the magnitude of this cross section.

13127. Meshkov, S., Rosen, S. P., **Lepton symmetry,** *Phys. Rev. Lett.* **29,** No. 26, 1764-1767 (Dec. 25, 1972).

Key words: Lepton; $m$-spin; neutrino; $SU(2)_M \times SU(2)_I$; trident production; weak interaction.

Assuming a weak interaction invariant under $SU(2)_M \times SU(2)_I$, we show that $M$-spin conservation leads to the rule $A(\nu_e e^-|\nu_e e^-) - A(\nu_\mu e^-|\nu_\mu e^-) = A(\nu_e \mu^-|\nu_\mu e^-)$ and to other sum rules for leptonic, semileptonic, and trident production processes. The additional assumption of total isospin conservation yields simple relations for lepton-hadron scattering. We also show that $\mu$ decay is forbidden in lowest order for various symmetry schemes such as the SU(3) and O(3) theories based upon the Konopinski-Mahmoud assignment of lepton number.

13128. Haber, S., **Experiments on optimal coefficients,** Chapter in *Applications of Number Theory to Numerical Analysis,* pp. 11-37 (Pergamon Press, Inc., New York, N.Y., 1972).

Key words: Algebraic numbers; approximation; diophantine approximation; exponential sums; functions of several

variables; geometry of numbers; good lattice points; numerical integration; optimal coefficients; periodicity; quadrature.

Methods for calculating parameters for quadrature formulas of the type defined by N. M. Korobov and E. Hlawka have been proposed by several authors. In this paper a number of sequences of such parameter sets are found, by methods due to L. K. Hua and Y. Wang, and to N. M. Korobov. An error bound for the quadrature formula corresponding to each parameter set is found, by a modification of a method of Korobov. Conjectures about the asymptotic properties of these error bounds are formulated. Practical questions about the various methods of calculating parameters are discussed.

**13129.** McCarter, R. J., **The pyrolysis of cellulose at rates approaching those in burning,** *Text. Res. J.* **42,** No. 12, 709-719 (Dec. 1972).

Key words: Accessibility; Arrhenius plots; burned celluloses; celluloses; combustion; crystallinity; decomposition; DP; DTA; flame-retardant; $KHCO_3$; kinetics; moisture; oxygen indexes; pyrolysis; reaction rates; temperature; TGA; thermal analysis.

The thermal decomposition of cellulose was studied by a new thermal method suited to the measurement of faster reaction rates and to the problem of detecting concurrent reactions.

The pyrolysis data for four types of relatively pure cellulose indicated successive supramolecular and molecular decomposition steps, either of which may control the decomposition rate contingent upon the temperature history. The molecular decomposition step is interpreted as a first-order depolymerization reaction with an activation energy of 40 1/2 kcal/gmol.

The data for cellulose treated with retardant (1.5 wt% $KHCO_3$) indicated two principal decomposition reactions. An initial lower-temperature reaction evolved principally $H_2O$ and $CO_2$ from well-dried samples. The following main decomposition reaction exhibited the same kinetic parameters as the counterpart depolymerization step of the untreated cellulose, but evolved different vapor products.

Tests and analyses of these celluloses at transitional stages of decomposition are summarized. The implications of the data concerning the mechanism by which the retardant functions are discussed.

**13130.** Shine, R. A., Linsky, J. L., **Physical properties of solar chromospheric plages. 1. Line profiles of the Ca II H, K and infrared triplet lines,** *Solar Phys.* **25,** 357-379 (Aug. 1972).

Key words: Observations of solar spectra lines; solar atmosphere; solar chromosphere; solar plages.

Double pass photoelectric observations are presented of five Ca II lines (H, K, 8498 Å, 8542 Å, and 8662 Å) in a number of solar plages of different degrees of activity, quiet regions, and a sunspot. The data are compared with previous work. All five lines show increasing emission together in plages and the least opaque of the infrared triplet lines appears to exhibit core emission prior to the more opaque members of the multiplet. The question of source function equality is considered and the differences and similarities among plage profiles and between plage and quiet profiles are shown qualitatively and quantitatively.

**13131.** Youden, W. J., **Randomization and experimentation,** *Technometrics* **14,** No. 1, 13-22 (Feb. 1972).

Key words: Experimental design; philosophy of design; randomization; restricted randomization.

Randomization, often specified as an indispensable requirement in experimental design, is required only when the order or position of the experimental unit influences the performance of the unit. Randomization, when required, may give an arrangement that is obviously undesirable and one that may doom the particular experimental program. A system of constrained randomization is proposed that eliminates the undesirable arrangements without sacrificing the customary gains achieved by randomization.

**13132.** Youden, W. J., **Enduring values,** *Technometrics* **14,** No. 1, 1-11 (Feb. 1972).

Key words: Interlaboratory comparisons; philosophy of design; physical constants; variance components.

Why do results obtained by different investigators characteristically disagree by more than would be expected by their estimates of uncertainty? Youden notes that everything gets changed in another laboratory, whereas the investigator can (or does) make only minor changes within his laboratory. The message of this paper—that only those bounds for uncertainty based on actual measurement will endure—is already beginning to have an impact on physical measurement. Designed experiments to estimate bounds to systematic error will replace fallible judgment based on feelings and not observation.

**13133.** Kurylo, M. J., **Absolute rate constants for the reactions $H + O_2 + M \rightarrow HO_2 + M$ over the temperature range 203-404 K,** *J. Phys. Chem.* **76,** No. 24, 3518-3526 (1972).

Key words: Flash photolysis; H atoms; reaction kinetics; resonance fluorescence.

Absolute rate constants for the reaction $H + O_2 + M \rightarrow HO_2 + M$ have been measured by the flash photolysis-resonance fluorescence technique. For M = He, rate measurements over the temperature range 203-404 K and pressure range 10-400 torr gave the Arrhenius expression $k_1^{He} = [6.66\ (+1.2, -1)] \times 10^{-33} \exp[(473 \pm 92)\text{cal mol}^{-1}/1.987T]$ cm$^6$ molecule$^{-2}$ sec$^{-1}$. Comparisons of third-order rate constants at 298 K gave relative deactivation efficiencies of $CH_4/N_2/He/Ar = 15.7:3.4:1.0:1.0$. The efficiency ratio of $N_2$ to He was 4.5 at 226 K.

**13134.** Sengers, J. V., **Transport properties of fluids near critical points,** (Proc. Int. School of Physics "Enrico Fermi," Varenna on Lake Como, Italy, July 27-Aug. 8, 1971), Chapter in *Critical Phenomena,* pp. 445-507 (Academic Press, Inc., New York, N.Y., 1971).

Key words: Binary liquids; critical phenomena; dense gases; phase transitions; thermal conductivity; transport properties; viscosity.

The paper reviews the situation concerning transport properties of fluids in the vicinity of critical points. Methods for measuring viscosity and thermal conductivity are examined and a critical assessment is presented of the experimental results. The paper covers the viscosity and thermal conductivity in binary liquid mixtures near the critical mixing point, in gases near the gas-liquid critical point and in liquid He I near the superfluid transition. The experimental results are interpreted in terms of current theoretical predictions.

**13135.** Martin, W. C., Sugar, J., Tech, J. L., **Application of Slater-Condon theory with configuration interaction to the $5d^{10}6s6p$, $5d^96s^26p$, $5d^{10}6s7p$, and $5d^{10}6s5f$ configurations in Hg I, Tl II, Pb III, and Bi IV,** *Phys. Rev. A* **6,** No. 6, 2022-2035 (Dec. 1972).

Key words: Atomic energy levels; atomic theory; bismuth; configuration interaction; lead; mercury; thallium.

The calculations were based on fitting radial parameters to the observed energy levels, but with a requirement of regularity in the behavior of each parameter value along the isoelectronic sequence. Some parameters or ratios of parameters were fixed at

values based on isoelectronic comparisons or adjusted Hartree-Fock values. The calculated levels, $g$ values, and $LS$ percentage compositions are given for each atom, and comparisons with experimental data are made. The results support new $5d^9 6s^2 6p$ levels recently found in Hg I, Tl II, and Bi IV, and one experimental $5d^9 6s^2 6p$ level in Pb III is rejected as unreal. The calculated ratio of the lifetimes of the Hg I $5d^{10}6s6p\,^3P_1^0$ and $^1P_1^0$ levels is compared with the experimental value. Some comparisons of calculated and observed isotope shifts are made for Hg I, Tl II, and Pb III. The leading percentages in the $jj$ coupling scheme are listed for levels having assigned $jj$ names ($5d^9 6s^2 6p$ levels in all four atoms and $5d^{10}6s7p$ levels in three atoms).

**13136.** Rowe, J. M., Rush, J. J., de Graaf, L. A., Ferguson, G. A., **Neutron quasielastic scattering study of hydrogen diffusion in a single crystal of palladium,** *Phys. Rev. Lett.* **29,** No. 18, 1250-1253 (Oct. 30, 1972).

Key words: Hydrogen diffusion; hydrogen in metals; jump diffusion; neutron scattering; palladium hydride; quasielastic scattering; single crystal.

The diffusion of hydrogen in a single crystal of palladium ($PdH_{0.03}$) has been studied by quasielastic neutron scattering. The results provide the best evidence yet obtained for the applicability of a simple jump model of hydrogen diffusion in a metal and confirm the predominant occupation of octahedral sites in the Pd crystal, with a mean residence time at 623 K of 2.8 psec between jumps.

**13137.** Eisenhart, C., Rosenblatt, J. R., **W. J. Youden, 1900-1971,** *Ann. Math. Statist.* **43,** No. 4, 1035-1040 (1972).

Key words: Experiment design; interlaboratory tests; statistics; Youden, W. J.

Youden's contributions to statistics are summarized. In experiment design, he was the originator of "Youden Squares," linked block and chain block designs, partially replicated Latin squares, and calibration designs. He developed an important new technique, the two-sample chart for graphical diagnosis of interlaboratory test results.

**13138.** Hanley, H. J. M., Barker, J. A., Parson, J. M., Lee, Y. T., Klein, M., **Comments on the interatomic potential for argon,** *Mol. Phys.* **24,** No. 1, 11-15 (July 1972).

Key words: Argon; cross sections; potential functions; second virial coefficient; viscosity coefficients.

Argon viscosity coefficients and second virial coefficients have been calculated for the potentials of Barker, Fisher and Watts, and of Parson, Siska and Lee. These potentials have strong physical foundations based on the representation of several microscopic properties of argon including recently measured cross-section data. An apparent slight discrepancy exists between the calculated and experimental values of the coefficients. The $11-6-8$ potential is also discussed. This potential, which apparently gives a satisfactory correlation of the microscopic properties of argon, is shown to be insufficiently flexible to represent the cross-section data.

**13139.** Hamilton, C. A., Johnson, E. G., Jr., **Analog computer studies of subharmonic steps in superconducting weak links,** *Phys. Lett.* **41A,** No. 4, 393-394 (Oct. 9, 1972).

Key words: Josephson junction; subharmonic steps.

Microwave radiation applied to certain types of Josephson junctions produces steps in the $V-I$ curve at voltages corresponding to subharmonics of the applied radiation. Analog studies show the existence of these steps to be strongly dependent on reactive elements connected to the junction.

**13140.** Peterson, R. L., **Magnetophonon structure in the longitudinal magnetoresistance of nonpolar semiconductors,** *Phys. Rev. B* **6,** No. 10, 3756-3764 (Nov. 15, 1972).

Key words: Boltzmann equation; magnetoresistance; semiconductors; transport theory.

The magnetophonon effect in nonpolar nondegenerate semiconductors is investigated by solving the Boltzmann equation exactly in the Ohmic limit for combined optical- and acoustic-phonon scattering of carriers in parallel electric and magnetic fields. The solution is used in computing the longitudinal magnetoresistance at several temperatures and ratios of acoustic-to-optical-phonon scattering. As this ratio increases from zero at intermediate temperatures, the Gurevich-Firsov (GF) resonance maxima are found to broaden and shift toward higher magnetic field, with pronounced minima developing at the resonance fields before the magnetophonon structure vanishes at large acoustic-phonon scattering. As the temperature increases, additional (pseudoresonance) minima develop between the GF extrema, and are comparable in amplitude to the latter when $kT$ approximates the optical-phonon energy. At these temperatures the GF extrema are minima, even in the absence of elastic scattering. The results are compared with displaced-Maxwellian computations. The various effects are explained by physical arguments, which suggest that the same effects should occur for polar materials also.

**13141.** Ogburn, F., **Microscopical measurements of thickness: Manipulation of the microscope,** *Plating,* pp. 1155-1157 (Dec. 1972).

Key words: Coating thickness; measurement of coating thickness; metallography; microscopy; thickness determination of coatings.

Measurements of coating thickness by the microscopical method are subject to large errors. Major sources of error arise in the manipulation of the microscope as opposed to sample preparation. These sources include calibration of stage micrometer, calibration of micrometer eyepiece, spontaneous motion of stage, alignment of micrometer eyepiece, positioning of interval to be measured relative to optic axis, spacing of binocular eyepieces, level of focus where focusing can change tube length, and chromatic aberrations.

**13142.** Olson, W. B., **The infrared spectrum of $CH_3D$. Ground state constants and perturbation allowed transitions,** *J. Mol. Spectrosc.* **43,** No. 2, 190-198 (Aug. 1972).

Key words: Infrared; molecular geometry; monodeuteromethane; perturbations; rotational constants; symmetric top.

The ground state rotational constants of $CH_3D$ have been determined by a simultaneous least squares fit of combination differences obtained from twelve infrared absorption bands recorded in the region of 2380-3160 $cm^{-1}$. The direct determination of $A_0$ and $D_0^K$ has been accomplished through combination differences obtained from transitions not ordinarily allowed in the infrared spectrum of a symmetric top molecule, but made possible through perturbations between excited rovibronic levels.

**13143.** Ruthberg, S., **The measurement of conductance to free molecular flow by substitution procedures,** *J. Vac. Sci. Technol.* **9,** No. 6, 1457-1469 (Nov.-Dec. 1972).

Key words: Clausing factors; free molecular flow; precision ionization gauges; stable vacuum systems; transmission probability; vacuum calibration; vacuum measurements.

A method is presented which yields an order of magnitude increase in precision in the measurement of conductance to free molecular flow. The technique utilizes a calibrated variable conductance as a reference in a true substitution procedure. A series line was used to study balanced and unbalanced conditions and to explore the effects of various factors on precision, such as flow stability, pump behavior, ionization gauge sensitivity and response, temperature, transients, and sorption. A parallel line was used for measurements on short tubes of small diameter. For this, an iteration technique was employed for the calibration of the variable conductance on an absolute basis. Ionization gauge resolution of 0.02% and linearity of better than 0.1% were achieved. Relaxation effects were apparent. Conductance measurement precision of a few parts per 1000 was obtained. Transmission probabilities for the small diameter, short tubes showed deviations of as much as 18% from the Clausing factors at length-to-radius ratios $\geq 1$, but approached the Clausing values as $l/r \rightarrow 0$. Deviations of $< 1\%$ from the Clausing value required $l/r \leq 0.05$.

**13144.** Rush, J. J., Schroeder, L. W., Melveger, A. J., **Dynamics of sodium and potassium bifluoride: Infrared, Raman, and neutron studies,** *J. Chem. Phys.* **56,** No. 6, 2793-2800 (Mar. 15, 1972).

Key words: Bending vibration; bifluoride ion, hydrogen bonding; infrared; lattice modes; neutron scattering; Raman; stretching vibration.

The crystal and molecular dynamic of $NaHF_2$ and $KHF_2$ have been studied by infrared and Raman spectroscopy and by neutron inelastic scattering. Infrared absorption spectra have been measured in the region of the bending ($\nu_2$) and asymmetric stretching ($\nu_3$) vibrations of $NaHF_2$ and $KHF_2$ containing 2%, 11%, and $\approx 80\%$ $DF_2^-$. The spectra show a rather striking reduction in the widths of the $DF_2^-$ absorption peaks as well as shifts in peak frequencies as the percent $DF_2^-$ is lowered toward a "defect" concentration. These results indicate that the considerable width of the infrared absorption bands assigned to the $\nu_2$ and $\nu_3$ modes in pure $NaHF_2$ and $KHF_2$ is associated with coupling of near-neighbor $HF_2^-$ oscillators having similar frequencies or energy states. The Raman spectrum for $NaHF_2$ shows peaks at 630.5 and 145 $cm^{-1}$ which can be unambiguously assigned, respectively, to the $HF_2^-$ symmetric stretching mode ($A_{1g}$) and the $E_g$ librational lattice mode. The $KHF_2$ Raman spectrum is similar to a previous result, with some differences in the frequencies of the lattice-mode peaks. The combined neutron and far-infrared spectra on $NaHF_2$ provide information on the acoustic and optical translational lattice modes. An approximate vibrational frequency distribution is derived from the neutron spectrum and compared with previous spectroscopic and theoretical results on $NaN_3$. A detailed assignment of the internal and lattice modes for both sodium and potassium bifluoride is presented.

**13145.** Powell, C. J., Mandl, A., **High-resolution measurements of Auger-electron and photoelectron structure in the secondary-electron energy distributions of aluminum, nickel, and copper,** *Phys. Rev. B* **6,** No. 12, 4418-4429 (Dec. 15, 1972).

Key words: Aluminum; Auger transitions; copper; electronic density of states; nickel; secondary-electron energy distribution; x-ray photoemission.

Measurements are reported of selected structure in the secondary-electron energy distributions of evaporated aluminum, nickel, and copper. The specimens were bombarded with 3-keV electrons and the secondary structure was measured with a resolution of 0.1 eV. For each metal, it was hoped to measure Auger transitions involving two relatively narrow inner-shell levels and the valence band in order to obtain information on the valence-band density of states. Attempts were made to observe the Al $KL_{2,3}M$ Auger-electron energy distribution expected at about 1470 eV. Structure was, however, observed with a high-energy edge of $1485.9 \pm 0.5$ eV and a breadth of 8-9 eV. This structure was interpreted as being due to photoemission of valence electrons by internally generated $K\alpha$ x rays and was similar to uv photoelectron energy distributions and to the calculated density of states. Inelastic scattering of the photoelectrons obscures the expected Al $KL_{2,3}M$ structure. Auger-electron peaks in the ranges 730-800 and 820-865 eV were measured in the secondary-electron energy spectra for nickel and copper, respectively. Structure was observed in the $L_3M_{2,3}M_{4,5}$ Auger transition (over a range of about 20 eV) that could be associated in part with the final atomic states and in part with over-all features of the 3*d*-band density of states as determined by soft-x-ray-emission spectroscopy and x-ray photoelectron spectroscopy. It is believed that Auger-electron spectra can yield useful data on changes of electronic structure (e.g., by alloying or by compounding) but, in general, density-of-states data cannot be derived from the Auger spectra without detailed knowledge of the final states expected after the Auger transition of interest.

**13146.** Redding, R. W., **Rotational levels of double-minimum potentials: The linear BAB molecule with unequal bond lengths,** *J. Mol. Spectrosc.* **38,** No. 2, 396-414 (May 1971).

Key words: Double-minimum potentials; large-amplitude vibrations; linear molecules; rotational constants; triatomic molecules; vibration-rotation Hamiltonian.

The rotational constants and energy levels for the linear BAB system are studied under the assumption of unequal A—B bond lengths. The quantum mechanical Hamiltonian is derived according to a formalism which allows for a large-amplitude antisymmetric stretching motion. A numerical integration technique is used to obtain solutions of the one-dimensional Schroedinger equation corresponding to a zeroth-order approximation of the Hamiltonian. The behavior of the resulting rotational constants for various heights of the barrier in the double-minimum potential is discussed.

**13147.** Brower, W. S., Parker, H. S., Roth, R. S., Waring, J. L., **Phase equilibrium and crystal growth in the system lithium oxide-molybdenum oxide,** *J. Crystal Growth* **16,** 115-120 (1972).

Key words: Alkali molybdates; crystal growth; phase equilibria.

The phase equilibrium relationships of the $Li_2MoO_4 - MoO_3$ system were determined in air. Two intermediate compounds were found to occur in the system and single crystals of these compounds were grown by the Czochralski technique. The first compound $Li_4Mo_5O_{17}$ was found to melt congruently at 544 °C. The x-ray pattern of $Li_4Mo_5O_{17}$ was indexed on the basis of a triclinic cell $a = 6.786$ Å, $b = 9.481$ Å, $c = 10.812$ Å, $\alpha = 107° 1'$, $\beta = 88° 48'$, $\gamma = 110° 12'$. The second intermediate compound $Li_2Mo_4O_{13}$ was found to melt incongruently at 568 °C, and to occur in two polymorphic forms. The x-ray pattern of the first form was indexed on the basis of a triclinic cell $a = 8.227$ Å, $b = 8.503$ Å, $c = 11.46$ Å, $\alpha = 95° 24'$, $\beta = 109° 17'$, $\gamma = 96° 31'$ and the second form was indexed on a similar triclinic cell $a = 8.192$ Å, $b = 8.597$ Å, $c = 11.580$ Å, $\alpha = 111° 17'$, $\beta = 93° 55'$ and $\gamma = 96° 5'$.

**13148.** Dick, C. E., Whittaker, J. K., Sparrow, J. H., **Kiloampere current and charge measurements of a 2 MeV pulsed electron source,** *Nucl. Instrum. Methods* **104,** 131-136 (1972).

Key words: Charge monitor; high frequency; integrator; low current monitor; 2 MeV electron accelerator.

A current monitor has been developed to measure the electron current pulse from the NBS 2 MeV pulsed electron generator. This monitor features low inductance and a risetime of the order of a hundred picoseconds, enabling it to faithfully reproduce high frequency components present in the electron beam pulse. In addition, a charge integrating system comprised of an integrating capacitor and a precision integrator has been developed to measure the total charge contained in the electron beam pulse.

**13149.** Choi, C. S., Mapes, J. E., Prince, E., **The structure of ammonium nitrate (IV),** *Acta Crystallogr.* **B 28,** Part 5, 1357-1361 (May 1972).

Key words: Ammonium nitrate; crystal structure.

The structure of ammonium nitrate (IV), the phase which is stable between − 18 and 32.3 °C, has been refined by least-squares methods with three-dimensional neutron diffraction data. 188 independent reflections were observed on a four-circle diffractometer with a neutron wavelength of 1.232 Å and a limiting $2\theta$ angle of 100°. The refinement, using anisotropic temperature factors and an isotropic secondary extinction parameter, gave a final weighted $R$ index of 0.028. The structure is orthorhombic, space group $Pmmn$, with two $NH_4NO_3$ formula units per unit cell. A two-dimensional network of hydrogen bonds between the nitrogen atoms of the ammonium group and the oxygen atoms at one corner of the nitrate groups forms infinite sheets parallel to the (001) planes of the crystal. Adjacent sheets are bound together by van der Waals forces. This structure is simply related to the structures of the higher temperature phases.

**13150.** Martin, W. C., Sugar, J., Tech, J. L., **Calculations of autoionizing $d^9s^2np$ levels in Zn I, Cd I, and Hg I,** *J. Opt. Soc. Amer.* **62,** No. 12, 1488-1492 (Dec. 1972).

Key words: Cadmium; mercury; spectra; zinc.

Three Rydberg series of the type $d^{10}s^2\ {}^1S_0 - d^9s^2np\ (J=1)$ are known in each of these spectra. We have made intermediate-coupling calculations for the configurations Zn I $3d^94s^24p$, $5p$; Cd I $4d^95s^25p$, $6p$; and Hg I $5d^96s^27p$. The Slater parameters were determined to about 15% accuracy by various methods, or were adopted from previous calculations. Percentage compositions in the $LS$ coupling scheme and in the scheme of highest purity are given for the three levels having $J=1$ in each configuration. The results establish the most appropriate designations for these levels and for all of the higher $d^9s^2np$ series members. Although the Zn I $3d^94s^24p\ (J=1)$ levels are found to be significantly perturbed, the calculated relative oscillator strengths of the three absorption transitions to these levels agree well with the experimental values. Some other comparisons with experiment are discussed, and the relative intensities of the three observed series within each spectrum are qualitatively explained.

**13151.** Casella, R. C., Trevino, S. F., **Group-theoretical selection rules in inelastic neutron scattering within the rigid-molecule model,** *Phys. Rev. B* **6,** No. 12, 4533-4539 (Dec. 15, 1972).

Key words: Group theory; inelastic; neutron; rigid-molecule; scattering; selection-rules.

The model-independent technique of Elliott and Thorpe (ET) is extended to apply to a class of models in which molecular units undergo translational vibrations with respect to each other and also librations, but in which the internal vibronics of the molecules are neglected. Within the model we find that the ET "structure function" $F^{(r)}(\mathbf{k})$, associated with irreducible representation $r$ and momentum transfer $\mathbf{k}$, can be written in the form $F^{(r)}(\mathbf{k}) = F^{(r)}(\mathbf{k}|R) + F^{(r)}(\mathbf{k}|\theta)$, where $R$ and $\theta$ signify translational and rotational oscillations. Moreover, the translational part is identical to that of ET except that the atomic scattering lengths $a_n$ which appear in their result are to be replaced by $\mathbf{k}$-dependent molecular form factors $a_n(\mathbf{k}')$. $F^{(r)}(\mathbf{k}|\theta)$ contains a vector form factor equal to $i\nabla_{k'}a_n(\mathbf{k}')$, where $\mathbf{k}'$ is related to $\mathbf{k}$ via a rotation. Mathematically, their result is contained in ours as a special case. Physically, we indicate how to use both procedures in concert, thereby aiding in the identification of $r$ as well as in separating the internal from external vibrations and among the latter, the translational and rotational parts thereof. At the Brillouin-zone boundary we employ the so-called multiplier representations, thereby achieving a simplification both of our results and theirs. By significantly reducing the number of phonon modes to be considered in complex molecular crystals, we have likewise increased the diagnostic power of this method which requires no detailed knowledge of force constants. It is hoped that our results will receive wide application in the identification of phonons in such crystals.

**13152.** Manghnani, M. H., Fisher, E. S., Brower, W. S., Jr., **Temperature dependence of the elastic constants of single-crystal rutile between 4 and 583 K,** *J. Phys. Chem. Solids* **33,** 2149-2159 (1972).

Key words: Elastic constants: oxide; rutile; single crystal; temperature dependence.

Measurements of all the six principal elastic constants of single-crystal rutile were made in the temperature range of 298-583 K. The temperature derivatives (in kb/deg) at 298 K are: $dC_{11}/dT = -0.510$, $dC_{33}/dT = -0.900$, $dC_{44}/dT = -0.220$, $dC_{66}/dT = -0.458$, $dC_{12}/dT = -0.580$, and $dC_{13}/dT = -0.330$. Measurements of the four modes, $C_{11}$, $C' = (C_{11} - C_{12})/2$, $C_{66}$, and $C_{110L} = (C_{11} + C_{12} + 2C_{66})/2$, were extended to 4 K. Two features related to the temperature and volume dependences of the lattice vibrational frequencies are revealed: first, all the measured $dC_{ij}/dT$ except $dC'/dT$ become less negative with increasing temperature above 100 K. Second, $dC'/dT$ is positive at all temperatures but decreases with increasing temperature at temperatures > 300 K. Indirectly shown is that $(\partial C'/\partial P)_T$ having a value of − 1.32 at 298 K, decreases with decreasing temperatures. The significance of this latter fact is discussed in light of the computation of Grüneisen mode $\gamma$'s from the acoustic $(\partial C_{ij}/\partial P)_T$ values, and the results are compared with $\gamma(\alpha_T)$ values obtained by Kirby from thermal expansion data. It is concluded that the large increase in $\gamma(\alpha_T)$ at low temperatures cannot be ascribed to a large temperature dependence of $(\partial C'/\partial P)_T$. Therefore, Kirby's explanation, that the large increase in $\gamma(\alpha_T)$ is caused by the large volume dependence of the acoustical mode frequencies, is not substantiated.

**13153.** Raveché, H. J., Mountain, R. D., Streett, W. B., **Three atom correlations in the Lennard-Jones fluid,** *J. Chem. Phys.* **57,** No. 11, 4999-5006 (Dec. 1, 1972).

Key words: Closure approximation; high pressure; Lennard-Jones potential; liquid densities; Monte Carlo method; triplet correlation function.

The Monte Carlo method has been used to compute the triplet correlation function in a classical fluid with Lennard-Jones interactions. The computations were performed for particular configurations at five thermodynamic states of high density. The structure of the triplet function is discussed in the liquid and dense gas regions. Several closure approximations, which express the triplet function in terms of the pair correlation function, are compared to the Monte Carlo results.

**13154.** Choi, C. S., Prince, E., **The crystal structure of cyclotrimethylene-trinitramine,** *Acta Crystallogr.* **B 28,** Part 9, 2857-2862 (Sept. 1972).

Key words: Crystal; crystal structure; cyclotrimethylene-trinitramine; explosives; neutron diffraction; organic compound; RDX.

The structure of cyclotrimethylene-trinitramine (RDX), $C_3H_6N_6O_6$, has been refined from single-crystal neutron-diffraction data. The final weighted $R$ index for 836 independent reflections is 0.021. The compound crystallizes in the orthorhombic space group $Pbca$, $a = 13.182$ (2), $b = 11.574$ (2), $c = 10.709$ (2) Å, $Z = 8$. The molecule consists of alternate $CH_2$ and $N - NO_2$ groups in a puckered ring. The environment of the carbon atoms is essentially tetrahedral, and the $N - NO_2$ groups are planar. The molecule possesses a plane of approximate mirror symmetry perpendicular to the plane defined by the three carbon atoms. The thermal motion may be described by rigid-body motion of the ring and separate rigid-body motion of the nitro groups.

**13155.** Bensema, W. D., **Coal mine magnetic-field noise measurements,** *Proc. First West Virginia Conf. on Coal Mine Electrotechnology, West Virginia University, Morgantown, W. Va., Aug. 2-4, 1972,* pp. XII-1–XII-12 (Aug. 1972).

Key words: Communication; field strength; measurement; mines; noise.

A semiportable measurement system was developed to measure the extremely low frequency magnetic noise spectrum in the frequency range from 40 Hz to 10 kHz. Ambient noise spectra from 40 to 3000 Hz are shown in an underground coal mine location. Magnetic field strengths vary from a high of − 20 dB relative to 1.0 ampere/meter measured at 60 Hz near an AC power bus, to a low of approximately − 138 dB measured at a quiet location underground at 500 Hz. Impulsive noise from nearby electric locomotives raise the background levels by approximately 34 dB. At locations remote from arcing locomotives, deep minima of 60 or more dB were found between harmonics of the 60 Hz powerline frequency. "Three dimensional" graphs are given showing some typical spectra as a function of time.

**13156.** Fano, U., **Field configurations and parameters that identify states with $j = 1$,** Chapter in *Spectroscopic and Group Theoretical Methods in Physics, Racah Memorial Volume,* F. Bloch, S. G. Cohen, A. De-Shalit, S. Sambursky, and I. Talmi, Eds., pp. 153-160 (North-Holland Publishing Co., Amsterdam, The Netherlands, 1968).

Key words: Angular momentum; atoms; molecules; nuclei; orientation.

This paper reviews the problem of identifying an arbitrary state within the set of degenerate energy eigenstates of a system isolated in space. For $j = 1$, it presents a description and interpretation of identifying parameters and of their ranges of variation which is summarized in section 5.

**13157.** Florin, R. E., Wall, L. A., **Radicals detected by electron spin resonance during fluorination of polymers,** *J. Chem. Phys. Letters to Editor* **57,** No. 4, 1791-1792 (Aug. 15, 1972).

Key words: Electron spin resonance; fluorination; free radicals; polymer reactions.

Radicals of both peroxyl and fluorohydrocarbon structure are observed by electron spin resonance when organic polymers such as polystyrene and polyethylene are exposed to dilute fluorine. The character of the reactions suggests that F-atoms are the initiation species in this type of direct fluorination process.

**13158.** Olver, F. W. J., Sookne, D. J., **Note on backward recurrence algorithms,** *Math. Computation* **26,** No. 120, 941-947 (Oct. 1972).

Key words: Bessel functions; difference equations; error bounds; FORTRAN; Miller's algorithm; recursion.

An algorithm is given for the computation of the recessive solution of a second-order linear difference equation, based upon a combination of algorithms due to J. C. P. Miller and F. W. J. Olver. A special feature is automatic and rigorous control of truncation error.

The method is illustrated by application to the well-used example of the Bessel functions $J_r(x)$.

**13159.** Hastie, J. W., **Formation of $H_2O_2$ by adiabatic expansion of $H_2 - O_2$ gas mixtures,** *Chem. Phys. Lett.* **17,** No. 2, 195-198 (Nov. 15, 1972).

Key words: Adiabatic expansion; hydrogen peroxide; mass spectrometry.

Mass-spectrometric studies of adiabatic expansions of $H_2 - O_2$ and $H_2 - O_2 - N_2$ gas mixtures have revealed the formation of the species $H_2 \cdot O_2$ at concentrations of the order of $10^{-5} - 10^{-4}$ mole fraction. This species is believed to be a relatively weakly bound isomer which is less stable than $H_2O_2$, the common form of hydrogen peroxide. A mechanism which is more consistent with the data is: $H_2 + H_2 + O_2 \rightarrow H_2 \cdot O_2 + H_2$.

**13160.** Rukwied, A., Ballard, D. B., **Scanning electron microscope fractography of continuously cast high purity copper after high temperature creep,** *Metallurgical Trans.* **3,** 2999-3008 (Nov. 1972).

Key words: Creep cavitation; fractography; high purity copper; impurity segregation structure; stereo scanning electron microscopy.

Fracture surfaces produced by high temperature creep were studied using the scanning electron microscope. The material investigated was continuously cast high purity copper containing a nodal impurity segregation structure at which grain boundary voids are formed during creep. The observed void shape suggests that vacancies are supplied mainly via grain boundaries, and also by enhanced diffusion via segregation nodes; the vacancies seem to originate mainly at internal sources. The known distribution of potential nucleation sites was used to study the efficiency of the segregation structure in nucleating voids under various test conditions. Within the range of conditions employed, three different fracture modes were observed in separate regions of the stress-temperature plane. The regions are sequentially denoted $A$, $B$, and $C$ as the temperature is increased at a given stress; they shift to lower temperatures as the stress is increased. In region $A$ fracture is initiated by extensive cavitation along grain edges (line of junction of three grains); cavitation at the segregation structure seems to be of secondary importance. In region $B$ formation and growth to coalescence of voids at segregation nodes governs fracture; the change of growth mechanisms with test conditions is discussed. In region $C$ fracture is controlled by plastic instability.

**13161.** Greer, S. C., Sengers, J. M. H. L., Furukawa, G. T., **Heat capacity near the consolute point in solid $CH_4 - Ar$,** *J. Chem. Phys.* **57,** No. 12, 5052-5058 (Dec. 15, 1972).

Key words: Argon; calorimetry; critical phenomena; heat capacity; methane; mixture, binary; solution, solid.

Measurements are reported of the heat capacity at saturated vapor pressure (essentially $C_p$) of the system $CH_4 - Ar$ near its solid-solid consolute point (62 K, 65% Ar). In contrast to the behavior of the heat capacity at binary liquid consolute points where there are striking anomalies, no large increase was observed for $CH_4 - Ar$. An abrupt increase of only about 13% occurred in the heat capacity near the transition. The possibility that the anomaly is suppressed by lattice strain effects is discussed.

**13162.** Leiss, J. E., **Modern electron linacs and new user needs,** *Proc. 1972 Proton Linear Accelerator Conference, Los*

*Alamos, N. Mex., Oct. 10-13, 1972,* Report No. LA-5115, UC-28, pp. 197-204 (Nov. 1972).

Key words: Accelerators; electron linacs; nuclear research; radiation applications.

Existing and future needs for linear accelerator developments and the possibility for linac technology to satisfy these needs are discussed. Two major needs for high duty cycle accelerators on the one hand and high peak pulse current accelerators on the other are identified.

**13163.** Rowe, J. M., Sköld, K., Flotow, H. E., Rush, J. J., **Quasielastic neutron scattering by hydrogen in the $\alpha$ and $\beta$ phases of vanadium hydride,** *J. Phys. Chem. Solids* **32,** 41-54 (Apr. 1971).

Key words: Activation energy; hydrogen diffusion; lattice sites; neutron scattering; phase transition; quasielastic scattering; vanadium hydride.

The diffusion of hydrogen in the $\alpha$ and $\beta$ phases of vanadium hydride has been studied by neutron inelastic scattering. Samples of $VH_{0.198}$, $VH_{0.403}$ and $VH_{0.570}$ were used to determine the temperature and concentration dependence of the diffusion in the $\alpha$-phase. An activation energy of $550 \pm 50$ K was derived from the temperature dependence of hydrogen diffusion in the $VH_{0.198}$ sample. The theoretical neutron scattering cross-section for jump diffusion among the octahedral and tetrahedral interstitial sites of body-centered cubic lattices has been derived and compared to the experimental results. No conclusions about the site occupation in the $\alpha$-phase can be drawn from these results. The data for the $\beta$-phase of $VH_{0.570}$ indicate an abrupt decrease in the diffusion rate at the $\alpha \rightarrow \beta$ transition.

**13164.** Czyz, W., Maximon, L. C., **Comments on high energy coherent diffractive production of multi-body states on nuclear targets,** *Acta Phys. Pol. Letters to Editor* **B3,** No. 6, 897-902 (1972).

Key words: Coherent production; diffractive production; Glauber model; hadron scattering; high energy scattering; multi-body states.

Arguments are given that the traditional, Glauber-like model for the multiple scattering of composite objects be modified to the extent of including relativistic deformation of the wave functions. It is argued that this modified formalism is a specific realization of Van Hove's model of coherent nuclear production of multi-body states and thus is sufficient to explain the astonishingly small nucleon total cross-sections that have been extracted from multi-boson production experiments. It is shown on the simple example of Lorentz-contracted oscillator wave functions that, to have Van Hove's effect present, the interaction between the components of the diffractively produced object must be of the order of magnitude of their masses.

**13165.** Harris, W. P., **A wide-range bridge for dielectric measurements,** *1971 Annual Report, Conf. on Electrical Insulation and Dielectric Phenomena, Williamsburg, Va., Nov. 1-3, 1971,* pp. 177-179 (National Academy of Sciences, Washington, D.C., 1972).

Key words: Amplifiers; capacitors; dielectric constant; dissipation factor; measurements.

By employing modern fast operational amplifiers (slewing rate of 1000 V/$\mu$sec) the useful frequency range of the bridge described several years ago as an ultra-low-frequency bridge, has been extended upward by approximately two decades. This gives it a frequency range of about nine decades, from $10^{-3}$ Hz to 1 MHz. A source capable of providing a second output shifted 90° from the primary output is required. Up to $10^5$ Hz, this is provided by a single commercial instrument. Above $10^5$ Hz, two sources are used, the second triggered by the first, with adjustable phase. The accuracy of the dielectric constant measurements is chiefly limited by the 0.1% uncertainty of the variable capacitors used. Phase shift in the inverters produces an error in the dissipation factor measurements, roughly proportional to frequency. The effect of this can be greatly reduced by using a substitution method, or a correction can be applied to direct measurements. A fast FET operational amplifier forms the heart of the detector, with high input impedance over the broad frequency range. Except at lowest frequencies, this bridge is characterized by rapid balancing, and extremely simple calculations.

**13166.** Bertozzi, W., Cooper, T., Ensslin, N., Heisenberg, J., Kowalski, S., Mills, M., Turchinetz, W., Williamson, C., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Deformation parameters of $^{152}$Sm by electron scattering,** *Phys. Rev. Lett.* **28,** No. 26, 1711-1713 (June 26, 1972).

Key words: Charge distribution; deformation parameters; electron scattering; high-energy electrons; rotational band; samarium-152.

We have measured the cross sections for excitation of the ground-state rotational band in $^{152}$Sm by high-energy electrons. The ground-state charge distribution has been determined including the deformation parameters $\beta_2$ and $\beta_4$ of the nuclear surface.

**13167.** Gillen, K. T., Douglass, D. C., Malmberg, M. S., Maryott, A. A., **NMR relaxation study of liquid $CCl_3F$. Reorientational and angular momentum correlation times and rotational diffusion,** *J. Chem. Phys.* **57,** No. 12, 5170-5179 (Dec. 15, 1972).

Key words: Diffusion constant; dipole relaxation; molecular; spin lattice; temperature dependent.

Using pulsed NMR techniques, values of the self-diffusion constant $D_s$ and the $^{19}$F spin-lattice and rotating frame relaxation times, $T_1^F$ and $T_{1\rho}^F$, have been obtained for $CCl_3F$ over its entire liquid range. ($\sim 150 - 450$ K). The dependence of $T_{1\rho}^F$ on the rotating field strength $\omega_1$ has been used to derive temperature-dependent values of the $^{35}$Cl spin-lattice relaxation time $T_1^{Cl}$ and the chlorine to fluorine spin-spin coupling constant $J_{^{19}F-^{35}Cl}$ ($= 11.9 \pm 0.4$ Hz, independent of temperature). Except at low temperatures where the intermolecular dipole-dipole relaxation mechanism is important, $T_1^F$ is dominated by the spin-rotation interaction $(T_1^F)_{sr}$. Using $D_s$ data to separate the dipole-dipole contribution from $T_{1sr}^F$ allows us to estimate values of the angular momentum correlation time $\tau_J$ over a 300° temperature range. Over the same temperature range, values of $T_1^{Cl}$ give the correlation times for molecular reorientation $\tau_{\theta,2}$. Although possible anisotropy in molecular motion and in the spin-rotation interaction precludes rigorous quantitative comparisons with rotational diffusion theory, the results for $\tau_J$ and $\tau_{\theta,2}$ are shown to be consistent with Gordon's extended $J$ diffusion model. In particular, at high temperatures the molecular reorientation is no longer described by the small angular steps in classical theory: near the critical temperature $\tau_J$ and $\tau_{\theta,2}$ become of comparable magnitude and correspond to angular steps approaching 1 rad.

**13168.** Pedersen, N. F., Finnegan, T. F., Langenberg, D. N., **Magnetic field dependence and $Q$ of the Josephson plasma resonance,** *Phys. Rev. B* **6,** No. 11, 4151-4159 (Dec. 1, 1972).

Key words: Josephson tunnel junction; magnetic field; microwave losses; quasiparticle interference current.

The results of an experimental study of the magnetic field dependence of the Josephson-plasma-resonance frequency and

linewidth in Pb — Pb oxide — Pb tunnel junctions are reported. In the presence of an external magnetic field, the plasma mode is found to be sensitive to an antisymmetric component of supercurrent density which is not observed in conventional measurements of the field-dependent critical current. The frequency and field dependence of the plasma-resonance linewidth are interpreted as evidence that the previously unobserved quasi-particle-pair-interference tunnel current predicted by Josephson exists and has the expected magnitude but the opposite sign.

**13169.** Finnegan, T. F., Wahlsten, S., **Observation of coherent microwave radiation emitted by coupled Josephson junctions,** *Appl. Phys. Lett.* **21,** No. 11, 541-544 (Dec. 1, 1972).

Key words: Junction array; radiation emmission; resonant tunnel junction.

We report here the results of a preliminary study of coherent microwave radiation emitted by a small array of interacting Josephson tunnel junctions, including the first direct observation of the superradiant state in pairs of junctions.

**13170.** Horton, W. S., Ballard, D. B., **Scanning electron microscope studies of oxidized pyrolytic graphite,** *Carbon* **10,** 499-502 (1972).

Key words: Circular holes; face versus edge oxidation; impurity effect on oxidation; layers; pyrolytic graphite; scanning electron microscope.

Specimens of pyrolytic graphite (PG) that had been previously used for kinetic oxidation studies, as well as some unoxidized specimens, were examined. The principal topographic features of oxidized PG faces included circular holes with flat bottoms and various depths. Some holes were basin-like at the top. The hole walls were striated showing layers parallel to the deposition surface. The bottom side (i.e., nearest the substrate) was more extensively oxidized than the top, and the hole diameters were an order of magnitude larger. In contrast to these essentially cylindrical pits were a few with the shape of a paraboloid of revolution. The edges had indications of circular holes also. However, a nibbled effect appeared more common. A major feature of a thick specimen was the nonuniformity of attack as a function of distance from the substrate surface. The large scatter of the earlier kinetic data is attributed to this varying reactivity.

**13171.** Olin, J. S., Thompson, B. A., Sayre, E. V., **Characterization of medieval window glass by neutron activation analysis,** (Proc. Developments in Applied Spectroscopy, St. Louis, Mo., Oct. 18, 1971), Chapter in *Developments in Applied Spectroscopy,* A. J. Perkins, E. L. Grove, E. F. Kaelble, and J. E. Westermeyer, Eds., **10,** 33-55 (1972).

Key words: Activation analysis; archeology; glass; manganese; medieval windows; potassium; sodium.

Analytical data on medieval glasses are presented which indicate that alkali ratios and manganese-alkali ratios may be characteristic of the "ash" used in the glass manufacture. Thus, such data may be helpful in establishing the provenance of medieval glasses.

**13172.** Rebbert, R. E., Ausloos, P., **Photolysis of methane: Quantum yield of C($^1$D) and CH,** *J. Photochem.* **1,** 171-176 (1972/73).

Key words: C-atoms; collisional deactivation; free radical reactions; methane; photolysis; quantum yields.

It is demonstrated that C($^1$D) and CH($^2\pi$) species are formed in the photodissociation of $CH_4$ at $\lambda = 123.6$ nm [$\Phi(C) = 0.4 \pm 0.1 \times 10^{-3}$, $\Phi(CH) = 5.9 \pm 0.5 \times 10^{-2}$] and at $\lambda = 104.8$-106.7 nm [$\Phi(C) = 6.5 \pm 0.5 \times 10^{-3}$, $\Phi(CH) = 0.23 \pm 0.03$]. There is no evidence for C or CH production at wavelengths where the photoionization quantum yield is equal to unity.

**13173.** Seitz, M. G., Walker, R. M., Carpenter, B. S., **Improved methods for measurement of thermal neutron dose by the fission track technique,** *J. Appl. Phys.* **44,** No. 1, 510-512 (Jan. 1973).

Key words: Fission tracks; glass; mica; microscopy; neutron dose measurements; uranium.

We describe scanning electron microscope and reflected light observations of fission tracks that lead to highly reproducible track density measurements for different observers. These new observational techniques are used to calibrate two uranium-doped glasses for neutron dose measurements. The glasses are available to other investigators.

**13174.** Wiederhorn, S. M., **A chemical interpretation of static fatigue,** *J. Amer. Ceram. Soc.* **55,** No. 2, 81-85 (Feb. 1972).

Key words: Crack propagation; fracture; glass; mechanical properties; strength.

The effect of water on the growth of cracks in glass is discussed. Crack motion is believed to result from a stress-enhanced chemical reaction between water and glass and is influenced strongly by the crack-tip $OH^-$ ion concentration. This hypothesis is supported by the observation that crack-velocity data can be correlated with measurements of pH in slurries of ground glass and water. Variation of the measured pH from 5 to 12, depending on glass composition, suggests a wide pH variation at crack tips. The types of chemical reactions that establish the slurry pH are discussed, and it is noted that the slurries behave as weak acids, buffered solutions, or salts of weak acids, depending on glass composition.

**13175.** Lias, S. G., Rebbert, R. E., Ausloos, P., **Gas phase pulse radiolysis of hydrocarbon mixtures; determination of the charge recombination rate coefficient and absolute rate constants of ion-molecule reactions of the *t*-butyl ion through a competitive kinetic method,** *J. Chem. Phys.* **57,** No. 5, 2080-2086 (Sept. 1, 1972).

Key words: Carbonium ions; hydrocarbons; ion-molecule reactions; neutralization; pulse radiolysis.

The gas phase pulse radiolysis of several neopentane-$d_{12}$-alkane mixtures has been studied with the purpose of examining the competition between the reaction of the fragment *t*-butyl ion with the alkane to form isobutane, $t\text{-}C_4D_9^+ + RH_2 \rightarrow i\text{-}C_4D_9H + RH^+$, and the neutralization of the *t*-butyl ion by an electron or $SF_6^-$ ion, $t\text{-}C_4D_9^+ + X^- \rightarrow$ products. Using a computer calculation which takes into account the pulse characteristics as a function of time, the yield of isobutane observed in the reaction with 2,3-dimethylbutane (for which $k_{rn}$ was accurately determined to be $5.7 \pm 0.5 \times 10^{-11}$ cm$^3$/molecule·sec) and the dose per pulse, rate coefficients of the competing neutralization reactions were determined. These are $\alpha = 1.92 \pm 0.2 \times 10^{-6}$ cm$^3$/molecule·sec for neutralization by an electron, and $0.40 \pm 0.04 \times 10^{-6}$ cm$^3$/molecule·sec for neutralization by the $SF_6^-$ ion. The latter value is independent of $SF_6$ concentration and both are independent of pressure between 40 and 200 torr. Finally, these values of the neutralization rate coefficients and yields of isobutane measured in the pulse radiolysis of neopentane in the presence of other added alkanes (2-methylpentane, 3-methylpentane, methylcyclopentane) are used to calculate absolute rate coefficients of the hydride transfer reactions between the $t\text{-}C_4D_9^+$ ion and these compounds; the values determined are in good agreement with those measured by other techniques. The unique feature of the competitive method described here consists of the fact that the positive ion which is neutralized can be identified by the conventional analysis of a known reaction product.

**13176.** Sieck, L. W., Gorden, R., Jr., Ausloos, P., **Energy-dependent ring opening of cycloalkane parent ions,** *J. Amer. Chem. Soc.* **94,** No. 20, 7157-7159 (Oct. 4, 1972).

Key words: Cycloalkanes; ion-molecule reactions; isomerization; mass spectrometry; photoionization; proton transfer reactions.

In contradiction to a previously held view it is demonstrated that cyclopropane parent ions do undergo ring opening. The extent of ring opening depends on the internal energy content of the ion. It is shown that the cyclic ion reacts with $NH_3$ in the following manner

$$c\text{-}C_3D_6^+ + NH_3 \rightarrow CD_2H_2N^+ + C_2D_4H \rightarrow CD_2H_3N^+ + C_2D_4$$

while the linear $C_3D_6^+$ ion reacts exclusively by deutron transfer

$$C_3D_6^+ + NH_3 \rightarrow C_3D_5 + NH_3D^+$$

The total rate constant for reaction of the $C_3D_6^+$ ions formed by photoionization of cyclopropane-$d_6$ is independent of the internal energy content ($k_{total} = 9.4 \pm 0.4 \times 10^{-10}$ cm³/molecule-sec). However, the relative rates of reactions 1, 2, and 3 are strongly dependent upon the photon energy [$k_3/(k_1+k_2) = 0.18$ and 0.75 at 10 and 11.6 – 11.8 eV respectively]. Additional experiments performed on $C_3D_6 - CH_3OH$ mixtures support the view that the fraction of the $C_3D_6^+$ ions which transfer a deuteron to $NH_3$ is representative of the fraction of acyclic $C_3D_6^+$ in the system.

**13177.** Ausloos, P. J., Lias, S. G., **Photochemistry in the far ultraviolet,** *Annu. Rev. Phys. Chem.* **22,** 85-107 (1971).

Key words: Absorption and emission spectroscopy; far (vacuum) ultraviolet; ion-molecule reactions; matrix isolation; photochemistry; photoionization; reaction kinetics; thermodynamic.

The 1969-70 literature relating to far ultraviolet photochemistry has been reviewed. In the limited space allocated to this chapter, the more relevant and controversial developments are confronted. An attempt is made to relate information from various sources in order to obtain a comprehensive view of the entire field.

**13178.** Sieck, L. W., Ausloos, P., **Reactions of the acetone cation. Implications for the radiolysis of acetone,** *Radiat. Res.* **52,** No. 1, 47-58 (Oct. 1972).

Key words: Acetone; energy transfer; ion-molecule reactions; mass spectrometry; radiolysis.

The reactions of the acetone and acetyl cation with acetone have been investigated in a photoionization mass spectrometer. Reaction of the acetone cation with $\leqq 0.3$ eV internal energy occurs essentially at every collision ($k = 8.4 \times 10^{-10}$ ml/molecule sec), but decreases slightly with an increase in internal energy. Two reaction channels are observed for the acetone cation: (a) $CH_3COCH_3^+ + CH_3COCH_3 \rightarrow (CH_3)_2COH^+ + CH_3COCH_2$ and (b) $CH_3COCH_3^+ + CH_3COCH_3 \rightarrow CH_3COCH_3COCH_3^+ + CH_3$. The $CH_3CO^+$ ion reacts mainly as follows: $CH_3CO^+ + CH_3COCH_3 \rightarrow CH_3 \cdot COCH_3COCH_3^+$ ($k \cong 4.6 \times 10^{-10}$ ml/molecule sec). At pressures above $10^{-3}$ torr $(CH_3)_2COH^+$ and $CH_3COCH_3COCH_3^+$ reacts further with acetone to produce $(CH_3COCH_3)_nH^+$. It is suggested that in liquid phase radiolysis experiments the acetone cation will react within $10^{-12} - 10^{-13}$ sec. Recent radiolysis experiments in which acetone was used as a solvent are discussed in the light of this premise.

**13179.** Allen, J. H., Bender, P. L., **Narrow line rubidium magnetometer for high accuracy field measurements,** *J. Geomagn. Geoelec.* **24,** No. 1, 105-125 (1972).

Key words: Geomagnetism; magnetometer; optical pumping.

Observations of Zeeman transitions in $Rb^{87}$ vapor can be used to make accurate measurements of the earth's magnetic field provided that the resonance lines are narrow enough so that the separate components of the transitions are resolved. However, the resulting relatively low signal-to-noise ratio makes it difficult to follow rapid changes in the field. Self-oscillating magnetometers have rapid response to magnetic field changes and high sensitivity, but poor long-term stability. The advantages of both approaches can be obtained with a compound magnetometer in which a self-oscillating magnetometer is locked with a long time constant to a narrow and well-resolved Zeeman transition. We designed and built two prototype optically pumped $Rb^{87}$ magnetometers of this kind, and carried out a stability test on them. Half-hour means of the magnetic field difference between the two were obtained for a period of nine and a half days. During this time local magnetic field activity ranged from quiet to disturbed and a sudden commencement occurred. The standard deviation of the individual half-hour difference values was 0.02 $\gamma$ (= 0.02 nanoteslas, or 0.2 microgauss).

**13180.** Goldman, D. T., **Properties of nuclides,** Section 8b in *American Institute of Physics Handbook, Third Edition,* D. E. Gray, Ed., pp. 8-6 – 8-91 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: Absorption cross section; magnetic moment; mass defect; nuclides; quadrupole moment; $q$-values; radiation.

All known nuclides both stable and radioactive are listed together with the following properties where measured or appropriate: mass defect; half-life or abundance; magnetic moment; quadrupole moment; type of radioactive decays and energies associated with them; thermal neutron activation cross section. Data available through 1968 have been used in preparing the Table.

**13181.** Haber, S., **On the existence of simple quadratures,** *Mich. Math. J.* **19,** 401-410 (1972).

Key words: Approximation theory; conditional convergence; infinite series; integration; quadrature; simples quadratures.

If $S$ is a set of functions that are Riemann integrable on [0,1], and a formula

$$\int_0^1 f(x)\,dx = \sum_{i=1}^{\infty} a_i f(x_i),$$

holds for every $f \in S$ – with the $a_i$ and $x_i$ fixed complex numbers, independent of $f$, and the $x_i$ all distinct – then the formula is called a "simple quadrature for $S$". It is known that there is no simple quadrature for the set of all functions continuous on [0,1]; in this paper simple quadratures are constructed for certain large classes of continuous functions.

**13182.** Greenspan, M., **Acoustic properties of liquids,** Section 3e in *American Institute of Physics Handbook, Third Edition,* D. E. Gray, Ed., pp. 3-86 – 3-98 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: Absorption; acoustics; attenuation; liquids; sound; speed of sound; velocity of sound.

Values of the speed and attenuation of sound in selected liquids, taken from the literature, are presented in a way which illustrates the systematics. References to major compilations are given.

**13183.** Coxon, B., **Proton magnetic resonance spectroscopy: Part I,** Chapter in *Advances in Carbohydrate Chemistry and*

*Biochemistry*, **27**, 7-83 (Academic Press, New York, N.Y., 1972).

Key words: Carbohydrates; Fourier transforms; instrumentation; iterative analysis of spectra; non-equivalence; proton magnetic resonance spectroscopy; superconducting solenoids.

Recent applications of proton magnetic resonance spectroscopy to the analysis of carbohydrates are discussed with particular emphasis on the use of superconducting solenoids.

Improvements in magnets, probes, signal-averaging systems and spectrometer consoles are described and also the advantages of using a variety of field frequency stabilization techniques and automatic control and data acquisition.

Detailed discussions of pulse-Fourier transform techniques and of computerized literature analysis of spectra are given.

**13184.** Smith, R. L., Russell, T. W., Case, W. E., Rasmussen, A. L., **A calorimeter for high-power CW lasers,** *IEEE Trans. Instr. Meas.* **IM-21,** No. 4, 434-438 (Nov. 1972).

Key words: Calorimetry; laser; laser calorimetry; laser energy measurement; laser power measurement.

A calorimeter is described that can measure megajoules of laser energy from CW lasers whose output wavelength is in the region from 1 to 11 $\mu$m. The calibration of this device is traceable to NBS electrical standards. This calorimeter can measure total energies from $3 \times 10^4$ to $10^7$ J. The laser power range this device can handle ranges from 300 to 100 000 W.

**13185.** Jones, M. C., **Computed total radiation properties of compressed oxygen between 100 and 1000 K,** *Int. J. Heat Mass Transfer* **15,** No. 11, 2203-2215 (Nov. 1972).

Key words: Computations; oxygen; thermal radiation properties.

The total emissivity, total band absorptance and Planck mean absorption coefficient of compressed oxygen have been computed in the temperature range 100-1000 K. Computations were based on published data for the spectral absorption coefficient and extrapolations above and below room temperature were performed in accordance with published theory. It was found possible to represent all of the total band absorptance results with a two-parameter correlation.

**13186.** Negas, T., **The $Ba_{1-y}Sr_yMnO_{3-x}$ system,** *J. Solid State Chem.* **6,** 136-150 (1973).

Key words: Alkaline earth oxides; nonstoichiometry; oxidation-reduction; phase equilibria; transition-metal oxides.

Subsolidus phase relations at ambient atmospheric pressure and elevated temperatures in the $Ba_{1-y}Sr_yMnO_{3-x}$ system were investigated by quenching, gravimetric, and x-ray diffraction methods. The system is not binary above ~ 1035 °C because of reactions with atmospheric oxygen. The air isobar, $P_{O_2} = 0.2$ atm. was characterized at 1225, 1375, 1490, and 1610 °C. Seven oxygen-deficient phases including a perovskite phase characterize the system. Their stability depends on the values of $y$ and $x$ in $Ba_{1-y}Sr_yMnO_{3-x}$. The cell dimensions of these phases expand as $x$ increases at fixed $y$. These seven modifications can be retained in stoichiometric form by oxidation at lower temperatures.

**13187.** Fuller, E. G., **Photonuclear physics, 1971,** *Proc. 5th Int. Betatron Symp., Bucharest, Romania, Oct. 18-23, 1971,* pp. 197-205 (Institute for Atomic Physics, Bucharest, Romania, Dec. 1972).

Key words: Experiment; neutrons; nuclear; photons; photonuclear; protons; reactions; theory.

A brief review is given of the present status of the photonuclear physics field. Recent new experimental data are described both in their historical context as well as in the light of recent theoretical work. Present trends in the field are indicated particularly with regard to new facilities and new techniques and their implication with regard to future experimental measurements and theoretical attempts to explain the data.

**13188.** Spencer, L. V., Simmons, G. L., **Improved moment method calculations of gamma-ray transport: Application to point isotropic sources in water,** *Nucl. Sci. Eng.* **50,** 20-31 (1973).

Key words: Gamma ray penetration; moments method; point gamma source in water; polynomial approximation; radiation transport; truncation error.

Estimated error bounds derived from polynomial calculations have been used to revise the truncation error estimates of published data on gamma-ray penetration in water. It is also shown that more efficient use of moment data is possible to obtain greater accuracy in specific penetration regions and to extend the accuracy of polynomial calculations to greater penetrations. The results also indicate that in addition to the asymptotic power law, data to perhaps 40 mean-free-paths may be needed to make accurate extrapolations to arbitrarily great penetrations.

**13189.** Unassigned.

**13190.** Turner, J. E., Dutrannois, J., Wright, H. A., Hamm, R. N., Baarli, J., Sullivan, A. H., Berger, M. J., Seltzer, S. M., **The computation of pion depth—dose curves in water and comparison with experiment,** *Radiat. Res.* **52,** 229-246 (1972).

Key words: Depth dose; dosimetry; ionization chambers; pions; radiobiology; transport calculations.

A Monte Carlo program has been written for calculating absorbed dose as a function of position in a water target irradiated by beams of pions ($\pi^+$ and $\pi^-$). The incident pions can have an arbitrary energy spectrum, at present limited to 125 MeV, this energy including most beams that have been used in radiobiological experiments. The presence of muons and electrons, which contaminate pion beams in practice, is also included. The incident particles may enter the target at any point and with any direction of travel. Calculations can thus be made for nonparallel, nonuniform beams. The size of cylindrical volumes in the target over which the absorbed energy is averaged can be varied to simulate the use of detectors of various dimensions. The calculations include pion-nucleus interactions, multiple coulomb scattering, pion and muon decay at rest, as well as the transport and further interactions of secondary protons and neutrons. Good agreement is obtained between calculated and measured depth-dose curves with $\pi^+$ and $\pi^-$ beams from the 600 MeV Synchrocyclotron at CERN. The program will be used to study various factors that affect the dose and LET patterns that can be obtained with realistic pion beams.

**13191.** Rains, T. C., Menis, O., **Determination of submicrogram amounts of mercury in standard reference materials by flameless atomic absorption spectrometry,** *J. Ass. Offic. Anal. Chem.* **55,** No. 6, 1339-1344 (Nov. 1972).

Key words: Flameless atomic absorption; liver and coal; loss of mercury; mercury in orchard leaves; standard reference materials.

In a study of the flameless atomic absorption method for the determination of nanogram amounts of mercury in organic materials, the technique was improved to provide greater precision and accuracy. The loss of mercury during the digestion of organic materials with nitric, sulfuric, and perchloric acids is

prevented by controlled heating and a packed refluxing column. The reduction and absorption system was simplified by using a heated absorption cell which alleviates the interference of volatile vapors. This method has been applied to the determination of mercury in NBS standard reference materials of orchard leaves, liver, and coal, and the results were compared with results obtained with two other analytical methods.

**13192.** Maienthal, E. J., Taylor, J. K., **Electrochemical techniques in water analysis,** Chapter 32 in *Water and Water Pollution Handbook,* L. L. Ciaccio, Ed., **4,** 1751-1800 (Marcel Dekker, Inc., New York, N.Y., June 1972).

Key words: Amperometry; chronopotentiometry; conductivity; coulometry; electrochemical analysis; polarography; potentiometry; water analyses; water pollution.

The uses of a variety of electrochemical methods of water analysis are described. The improved accuracy, sensitivity, selectivity, and ease of automation make these techniques the prime choice in many analytical problems concerned with water pollution and water analyses. The principles and applications of such methods as conductivity, potentiometry, amperometry, coulometry, chronopotentiometry, and polarography are discussed.

**13193.** Horn, W. A., **Single-machine job sequencing with treelike precedence ordering and linear delay penalties,** *SIAM J. Appl. Math.* **23,** No. 2, 189-202 (Sept. 1972).

Key words: Decision networks; minimum delay programs; network; network optimization; optimal sorting; sorting networks.

The problem treated is one of job sequencing on a single machine, where there is a precedence ordering between certain of the jobs, as given by a directed network which is a tree or a set of disjoint trees (a forest). The jobs form the nodes of the forest. The rule of precedence states that no job may be done before all those preceding it in its particular tree have been finished, and a job schedule is allowable if it obeys this rule. A penalty is assigned to each allowable schedule and is defined as the sum of delays for jobs, each multiplied by a number which represents the "value" or importance of that job. All delays are measured from time 0. Simple algorithms are given to find an allowable solution with minimum penalty in the two cases where all precedence relations in each tree go "inward," toward the root, or "outward," away from the root (where the root is a particular tip node of the tree).

**13194.** Weisman, I. D., Bennett, L. H., Maxwell, L. R., Sr., Woods, M. W., Burk, D., **Recognition of cancer in vivo by nuclear magnetic resonance,** *Science* **178,** 1288-1290 (Dec. 22, 1972).

Key words: In vivo; mouse; nuclear magnetic resonance; relaxation time; tumor.

Pulsed nuclear magnetic resonance has been used to differentiate in vivo between normal mouse tail tissue and a malignant transplanted melanoma, S91, located on the tail. The tumor displayed a nuclear (proton) spin-lattice relaxation time of ~ 0.7 second contrasted with the simultaneously measured normal tail tissue relaxation time of ~ 0.3 second.

**13195.** Kuriyama, M., **The dynamical scattering amplitude of an imperfect crystal. II. A relation between Takagi's dynamical equation and a more exact dynamical equation,** *Acta Crystallogr.* **A28,** Part 6, 588-593 (Nov. 1972).

Key words: Dynamical diffraction; imperfect crystal; scattering matrix.

A basic equation of dynamical diffraction for an imperfect crystal is derived based on a general dynamical theory of diffraction. This equation is given in the form of a differential equation, and therefore can be considered to describe the diffraction processes locally inside a crystal. A phenomenological interpretation of this equation helps to fill in the gap between modern quantum mechanical treatments and ordinary treatments by dynamical theory of diffraction for a perfect crystal. In the approximation of poor resolution the more exact equation reduces to Takagi's equation. A necessary condition which makes Takagi's equation valid leads to the concept of local reciprocal lattice vectors.

**13196.** Reader, J., Epstein, G. L., **Analysis of the spectrum of doubly ionized rubidium (Rb III),** *J. Opt. Soc. Amer.* **62,** No. 12, 1467-1476 (Dec. 1972).

Key words: Rubidium; spectra; ultraviolet; wavelengths; Zeeman effect.

The spectrum of Rb III has been observed in a sliding-spark discharge with the NBS 10.7-m normal-incidence vacuum spectrograph, and in an electrodeless discharge in a magnetic field with the NBS 10.7-m Eagle spectrograph in air. The analysis has yielded most of the levels of the $4p^4 4d$, $4p^4 5s$, and $4p^4 5p$ configurations. The $4p^4 5p$ levels and the $4s^2 4p^4 4d + 4s^2 4p^4 5s + 4s 4p^6$ group of levels have been theoretically interpreted, with configuration interaction included. The energy parameters determined from a least-squares fit to the observed level values are compared with Hartree-Fock calculations. The ionization energy is estimated to be $39.0 \pm 0.3$ eV.

**13197.** Sadowski, W. L., Lozier, D. W., **Use of Olver's algorithm to evaluate certain definite integrals of plasma physics involving Chebyshev polynomials,** *J. Comput. Phys.* **10,** No. 3, 607-613 (Dec. 1972).

Key words: Asymptotic solutions; Chebyshev polynomials; difference equations; evaluation of integrals; numerical stability; Olver's algorithm; plasma physics; recurrence relations.

The paper presents three methods of evaluating a sequence of definite integrals involving Chebyshev polynomials of the first kind. The integrals arise in a nonlinear plasma physics problem. It is shown that the first algorithm suffers such a loss of precision that the computed sequence diverges. The second algorithm yields results that lose all significance for higher terms in the sequence, although the sequence does not diverge.

The problem is then formulated in terms of a three-term inhomogeneous recursion. Asymptotic analysis shows that neither forward nor backward recursion is stable. Olver's algorithm provides a method with an a-priori error bound for calculating the sequence of integrals.

Tables of values obtained by the three methods are compared.

**13198.** Evenson, K. M., Mizushima, M., **Laser magnetic resonance of the $O_2$ molecule using 119- and 78-$\mu$m $H_2O$ laser lines,** *Phys. Rev. A* **6,** No. 5, 2197-2204 (Dec. 1972).

Key words: $H_2O$ laser; laser magnetic resonance; laser spectroscopy; $O_2$; 119; 78 $\mu$m.

Laser magnetic resonance of the $O_2$ molecule is observed using the 119- and 78-$\mu$m lines of the $H_2O$ laser. The relevant transitions for the 119-$\mu$m line are $(N=13, J=14, M) \rightarrow (N=15, J=14, M')$, and those for the 78-$\mu$m line are $(N=21, J=22, M) \rightarrow (N=23, J=22, M')$, where $M'=M$ or $M \pm 1$ depending on the polarization. It is found that $g_\perp = 2.0044 \pm 0.0008$, $g_z = 2.0020 \pm 0.0001$, $g_n = 0.000125 \pm 0.000008$ give slightly better

agreement between theory and experiment than Hendrie and Kusch's values ($g_\perp = 2.005169$, $g_z = 2.001939$, $g_n = 0.000122$) and Bauer, Kamper, and Lustig's values ($g_\perp = 2.004838$, $g_z = 2.002025$, $g_n = 0.000126$), but the present experimental accuracy is not high enough to exclude these older $g$-factor values. Using the existing microwave data and the known laser frequencies, the zero-field frequencies for the transitions $(N=J=13) \rightarrow (N=J=15)$ and $(N=J=21) \rightarrow (N=J=23)$ are found to be $2496.283 \pm 0.30$ and $3865.81 \pm 0.03$ GHz, respectively. Combining these results with the frequency of the $(N=J=1) \rightarrow (N=J=3)$ transition obtained by McKnight and Gordy, we obtain $B_0 = 43.100518 \pm 0.000020$ GHz, $B_1 = -0.14496 \pm 0.00030$ MHz, and $B_2 = -0.17 \pm 1.00$ Hz.

**13199.** Boyle, D. R., Clague, F. R., Reeve, G. R., Wait, D. F., Kanda, M., **An automated precision noise figure measurement system at 60 GHz,** *IEEE Trans. Instrum. Meas.* **IM-21,** No. 4, 543-549 (Nov. 1972).

Key words: Analysis; automation; noise figure; $Y$-factor.

As part of a millimeter-wave development program at the National Bureau of Standards, a precision measurement method and system was devised to automatically measure the effective input noise temperature of 55-65-GHz receivers.

Salient features of the system include a bolometric $Y$-factor measurement, a working "hot" noise source consisting of a waveguide argon gas tube mount developed at the National Bureau of Standards, and a minicomputer system controller operating in Basic. System design considerations and measurement uncertainties are discussed.

**13200.** Jennings, D. A., Keller, R. A., **Detection of trace amounts of sodium by fluorescence emission excited by a continuous wave organic dye laser,** *J. Amer. Chem. Soc.* **94,** 9249 (1972).

Key words: Analytical; cw organic dye laser; fluorescence; laser; sodium vapor.

A cw organic dye laser was used to excite fluorescence in atomic sodium vapor. Fluorescence was visible at 80 °C, which corresponds to a vapor pressure of $1.5 \times 10^{-8}$ mm of Hg. The concentration of sodium atoms at this pressure is 16 fg/cm$^3$ or $4.2 \times 10^8$ molecules/cm$^3$. Measurements were actually made in a volume of approximately a mm$^3$, which corresponds to 0.016 fg or $4.2 \times 10^5$ molecules.

**13201.** Chappell, S. E., Humphreys, J. C., **The dose-rate response of a dye-polychlorostyrene film dosimeter,** (Proc. Annual Conf. on Nuclear and Space Radiation Effects, Seattle, Wash., July 24-27, 1972), *IEEE Trans. Nuclear Science* **NS-19,** No. 6, 175-180 (1972).

Key words: Absorbed dose; dye-polychlorostyrene film dosimeter; high-intensity pulsed electron source; thin aluminum calorimeters; $^{60}$Co gamma-ray source.

The responses of dye-polychlorostyrene film dosimeters are compared at low ($\sim 10^3$ rad/sec) and high ($\sim 10^{15}$ rad/sec) dose rates. Low dose rate exposures were obtained with a $^{60}$Co gamma-ray pool source, and high dose rates were obtained with a high-intensity, pulsed electron source. The dosimeter is a solid solution of polychlorostyrene and malachite green methoxide which changes color upon irradiation. Two broad absorption peaks appear in the visible region with maxima at about 425 and 625 nm. The change in optical density of the 625-nm peak was monitored and correlated to the absorbed dose received by the dosimeters. At low dose rates, the source output was determined on the basis of a previous calibration with a carbon calorimeter and a cavity ionization chamber; at high dose rates, a thin dosimeter calibration system was employed. The calibration system has as its primary measuring elements aluminum calorimeters whose temperatures after exposure were monitored by chromel-constantan thermocouples. Associated electronics recorded the outputs of the thermocouples at every 0.1 sec. In the two cases, the dosimeters were exposed in a different but homogeneous medium, carbon or polystyrene at the low dose rates and aluminum at the high dose rates. In addition, Monte Carlo calculated stopping power ratios of the dye-film dosimeter to the medium were required to interpret the dose received by the dosimeters. The results indicate that there is no significant difference in the response at the two different rates.

**13202.** Lide, D. R., Jr., Johnson, D. R., Sharp, K. G., Coyle, T. D., **Microwave spectrum and barrier to internal rotation in $CF_3SiF_3$,** *J. Chem. Phys.* **57,** No. 9, 3699-3703 (Nov. 1, 1972).

Key words: Barrier to internal rotation in $CF_3SiF_3$; microwave spectrum; torsional mode.

The microwave spectrum of $CF_3SiF_3$ has been analyzed. The ground-state constants are $B_0 = 1328.464 \pm 0.001$ MHz, and $D_J = 0.09 \pm 0.05$ kHz. An extensive series of torsional satellite lines has been studied in some detail. The barrier to internal rotation is found to be $489 \pm 50$ cm$^{-1}$, corresponding to a torsional frequency of $37.0 \pm 2.0$ cm$^{-1}$. The lowest degenerate rocking mode has been determined as $158 \pm 12$ cm$^{-1}$. Other vibrational fundamentals are discussed.

**13203.** Ogburn, F., Smit, J., **Fluorescent x-ray methods for the measurement of coating thickness,** *Plating,* pp. 149-152 (Feb. 1973).

Key words: Coating thickness; electroplating; fluorescent x rays; thickness: x-ray spectrometry.

The use of x-ray spectrometry to measure the thickness of electroplated coatings is outlined. Sources of errors are calibration standards, dead time of x-ray detector and associated electronics, deformation of specimen, nonuniformity of coating thickness, background radiation, polychromaticity of x-ray source, density variations, metallic impurities, and excitation of characteristic radiation of coating material by characteristic radiation from substrate material. Techniques of minimizing these errors are discussed.

**13204.** Fatiadi, A. J., **The mechanism of formation of tris(phenylhydrazones) on treatment of cyclohexane-1,3-diones with phenylhydrazine,** *Carbohydrate Res.* **25,** 173-186 (Dec. 1972).

Key words: Cyclohexane-1,3-dione; formation; free-radical; ionic; mechanism; phenylhydrazine.

Treatment of the enolic cyclohexane-1,3-diones in aqueous acetic acid with an excess of phenylhydrazine at room temperature gave mixtures of the corresponding 2-oxo-1,3-bis(phenylhydrazone) and tris(phenylhydrazone) derivatives in low to moderate yield. E.s.r. study of the reaction path indicated that free-radical anionic intermediates are partially involved. Treatment of an enolic cyclohexane-1,2-dione (or of $\alpha$-hydroxy or $\alpha$-acetoxycyclohexanones) with phenylhydrazine gave mixtures of the corresponding mono- and bis(phenylhydrazones); formation of radical-anions was also observed in these reactions.

**13205.** Miller, R. C., Kidnay, A. J., Hiza, M. J., **Liquid-vapor equilibria at 112.00 K for systems containing nitrogen, argon, and methane,** *AIChE J.* **19,** No. 1, 145-151 (Jan. 1973).

Key words: Argon; binary system; excess Gibbs energy; liquid-vapor; methane; nitrogen; phase equilibria; ternary system.

Liquid-vapor phase equilibria measurements were made at 112.00 K on the binary systems nitrogen-argon, nitrogen-methane, and argon-methane and the ternary system nitrogen-argon-methane. Values of $g^E$, the excess Gibbs free energy, have been calculated from the experimental data for all the systems studied. The data and derived $g^E$ values for the binary systems were compared with the results of previous investigations with satisfactory agreement.

**13206.** Krauss. M., Neumann, D., Wahl, A. C., Das, G., Zemke, W., **Excited electronic states of $O_2^-$,** *Phys. Rev. A* **7,** No. 1, 69-77 (Jan. 1973).

Key words: Adiabatic correlation; asymptotic states; configuration interaction; correlation energy; excited states; multiconfiguration self-consistent field; $O_2^-$.

Excited electronic states of the $O_2^-$ molecule have been calculated with configuration-interaction (CI) variational trial functions that assure formally correct asymptotic behavior as well as the single-configuration self-consistent-field (SCF) approximation. CI results were obtained by both multiconfiguration self-consistent-field (MC-SCF) and pseudonatural orbital (PNO) techniques. The MC-SCF results are most accurate and are used to analyze the energy curves and wave functions of these states for internuclear separations larger than 3 a.u. All the excited states are found to have equilibrium-internuclear separations at least 1 a.u. larger than the ground state. The two lowest energy states, the $^4\Sigma_u^-$ and $^2\Pi_u$, are characterized, respectively, as shape and valence Feshbach resonances. They are sufficiently bound to make it likely they play a role in low-energy-electron scattering by oxygen.

**13207.** Zalubas, R., Borchardt, B. R., **Energy levels of neutral praseodymium (Pr I),** *J. Opt. Soc. Amer. Letters to Editor* **63,** No. 1, 102-103 (Jan. 1973).

Key words: Atomic energy levels; first spectrum of praseodymium (Pr I); spectrum.

The spectrum of atomic praseodymium has been observed with variety of light sources and spectrographs. The Zeeman effect has also been recorded. Three levels of $4f^36s^2\ ^4I^\circ$ ground term and 62 even high levels of Pr I have been found.

**13208.** Mauer, F. A., Hahn, T. A., **Thermal expansion of some azides by a single crystal x-ray method,** (Proc. AIP Conf. on Thermal Expansion, Corning, N.Y., Oct. 27, 1971), Chapter in *Thermal Expansion,* M. G. Graham and H. E. Hagy, Eds., No. 3, 139-150 (1972).

Key words: Azides; thermal expansion.

A modification of the Bond technique is used to measure the lattice constants of small crystals with an error of a few parts in $10^5$ throughout the temperature range − 180 to 325 °C. Temperature calibration has been investigated and the results of thermal expansion measurements on $KN_3$ and $Ba(N_3)_2$ are reported.

**13209.** Hahn, T. A., Kirby, R. K., **Thermal expansion of fused silica from 80 to 1000 K − Standard Reference Material 739,** (Proc. AIP Conf. on Thermal Expansion, Corning, N.Y., Oct. 27, 1971), Chapter in *Thermal Expansion,* M. G. Graham and H. E. Hagy, Eds., No. 3, 13-24 (1972).

Key words: Fused silica; standard reference material; thermal expansion.

Fused silica is the second of a series of materials to be certified as thermal expanion standards by the National Bureau of Standards. The results of tests of five samples indicate the stock to be consistent quality suitable for certification as Standard Reference Material 739. The same interferometer apparatus was used as in the certification of copper SRM 736. Expansivity values from each of the five samples were fitted using a least squares third order spline polynomial with three separate temperature intervals. The data from all the samples were then pooled and fit with the same type spline polynomial. Values calculated from these equations and their integrals are presented and also compared to literature data on fused silica.

**13210.** Huebner, R. H., Mielczarek, S. R., Kuyatt, C. E., **Electron energy-loss spectroscopy of naphthalene vapor,** *Chem. Phys. Lett.* **16,** No. 3, 464-469 (Oct. 15, 1972).

Key words: Electron energy-loss spectroscopy: naphthalene vapor: Rydberg states: oscillator strength.

The naphthalene energy-loss spectrum from 3 to 16 eV obtained for 100 eV incident electrons closely resembles photoabsorption results. The need to include Rydberg configurations for any theoretical analysis of the spectrum is emphasized. The data yield an integrated oscillator strength of 8.6 below 15.1 eV.

**13211.** Wachtman, J. B., Jr., Dundurs, J., **Large localized surface stresses caused by thermal expansion anisotropy,** *J. Amer. Ceram. Soc. Discussion and Notes* **54,** No. 10, 525-526 (Oct. 1971).

Key words: Grain size; Griffith equation; Petch equation; thermal expansion anisotropy; strength; surface stress.

The stress in the surface of a polycrystalline solid arising from thermal expansion anisotropy is calculated from a model of an elastic sphere in a homogeneous material. The results depend strongly on the distance of the sphere from the surface and suggest that the usual calculation, which ignores the effect of the surface, seriously underestimates this stress.

**13212.** Eisen, H., Rosenstein, M., Silverman, J., **Electron depth-dose distribution measurements in two-layer slab absorbers,** *Radiation Res.* **52,** No. 12, 429-447 (Dec. 1972).

Key words: Depth-dose; dose distribution; dosimetry; dye film; electron beams; film dosimeter; interfaces; Monte Carlo; radiochromic dyes; two-layer slabs.

Electron depth-dose distribution measurements were made using the Chalkley-McLaughlin dye film dosimeter in two-layer slab absorbers of polystyrene-copper, polystyrene-tin, and aluminum-gold. A plane-parallel 2.0-MeV electron beam was used. Data were obtained for 12 cases by varying the location of the interface and by reversing the order of the slab components. Reproducibility of the measurements was ±6 percent (2 $\sigma$). An investigation of stopping-power ratio evaluation methods based on the treatment of the film dosimeter as a nonperturbing cavity demonstrated that a constant value could be used for each material in a two-layer absorber independent of the thickness of each layer. The error in absorbed dose determination introduced by the use of a constant value ranged up to 8 percent. A film placed at the interface between the two components of the slab was used to estimate the dose at the interface surfaces. Corresponding theoretical calculations were made using a multilayer electron transport computer code developed by Berger. Agreement between the measured and the calculated doses was within 10 percent for metal layers and within 15 percent for polystyrene. The discrepancies for polystyrene can be attributed to the omission of energy loss straggling in the calculation.

**13213.** McNeil, M. B., Pearson, W. B., Bennett, L. H., Watson, R. E., **Stabilization and chemical bonding in Zintl phases,** *J. Phys. C* **6,** 1-10 (1973).

Key words: Chemical bonding; phase stabilization; pseudopotential; Zintl phases.

The factors affecting the formation of B32 Zintl phases are examined. Evidence is presented that the pseudopotential effects discussed by others have not been shown to be essential, and that the structures must still be accounted for largely by geometric factors.

**13214.** Penner, S., Lightbody, J. W., Jr., Fivozinsky, S. P., Crannell, H., Hallowell, P. L., Finn, M., **Electron scattering studies of vibrator-spectrum nuclei,** (Proc. Int. Conf. on Nuclear Structure Studies Using Electron Scattering and Photoreaction, Sendai, Japan, Sept. 12-15, 1972), Paper in *Nuclear Structure Studies Using Electron Scattering and Photoreaction,* K. Shoda and H. Ui, Eds., **5,** 49-60 (Laboratory Report of Nuclear Science, Tohoku University, Tomizawa, Sendai, Japan, 1972).

Key words: Anharmonic vibrators; electron scattering; form factors; quadrupole moments, vibrator nuclei, $^{52}$Cr, $^{110}$Pd, $^{114}$Cd, $^{116}$Sn.

Inelastic electron scattering is being used to study vibrator-spectrum nuclei in the medium-A region. In many cases we find that the second $2^+$ ("two phonon") state is much more strongly excited than is predicted by the harmonic vibrator model. The shapes and magnitudes of the form factors of these states can be fitted by calculations based on an anharmonic model in which mixing of one- and two-phonon wavefunctions is included. An experiment is underway to measure inelastic scattering form factors in $^{52}$Cr, $^{110}$Pd, $^{114}$Cd, and $^{116}$Sn. In all of these nuclei we find that the second $2^+$ state is strongly enhanced compared to the harmonic vibrator model prediction.

**13215.** Clark, A. F., Tryon, P. V., **Material variability as measured by low temperature electrical resistivity,** *Cryogenics* **12,** No. 6, 451-461 (Dec. 1972).

Key words: Aluminum alloys; cryogenic; electrical resistivity; low temperature; material variability; nickel alloy; stainless steels; statistics.

Low temperature electrical resistivity was used to determine the material variability (a) between different manufacturers, (b) between different heats from the same manufacturer, and (c) within a given heat for Al 2024, Al-5 percent Mg alloys, Inconel 718, A286 stainless, and AISI 316. Generally, the coefficient of variation for solution annealed alloys ranged from 1.2 to 14 percent between manufacturers, 0.8 to 5.1 percent between heats, and 0.1 to 1.6 percent within a heat with stainless steels at the low ends and Al 2024 at the high ends. The variability is increased if the material is in a precipitation-hardened condition. A statistical analysis suggests that the variability within a heat is non-normal. It is also shown that precipitation increases the intrinsic resistivity.

**13216.** Bolz, L. H., Reneker, D. H., Yee, K. W., **Ultrasensitive logarithmic picoammeter for exposure and dose measurement in electron microscopy of polymer crystals,** *J. Phys. E* **5,** No. 11, 1039-1041 (Nov. 1972).

Key words: Electron collection efficiency; electron microscope exposure meters; logarithmic picoammeter; polymer crystals; polymer electron microscopy; radiation damage to polymers.

Measurements of electron beam currents for determination of photographic exposure times and for determination of the radiation dose to which the sample was subjected were facilitated by a logarithmic picoammeter which indicated currents as low as would produce a useful image in a few seconds on a fast emulsion. Since the meter was logarithmic it also indicated the much higher currents ordinarily used without a scale change. Calibration of the electron collection efficiency of the focusing screen used to collect the current enabled the actual current density at the sample to be determined.

**13217.** Caswell, R. S., Coyne, J. J., **Interaction of neutrons and secondary charged particles with tissue: Secondary particle spectra,** *Radiat. Res.* **52,** No. 3, 448-470 (Dec. 1972).

Key words: Energy deposition; microdosimetry; neutron interaction with tissue; secondary particle spectra.

Theoretical calculations have been made of the secondary particle spectra for $p$, $d$, $\alpha$, $^{9}$Be, $^{11}$B, $^{12,13,14}$C, $^{14,16}$N, and $^{16}$O produced by interactions of 1- and 14-MeV neutrons with a four-element tissue containing the elements H, C, N, O. Detailed neutron cross-section data have been used in the calculation. Both "initial" spectra of the secondary particles as produced by nuclear reactions and the "equilibrium" spectra produced by particles slowing down are determined. This work is the first step in development of a quantitative description of the "physical" stage in the action of neutron radiation on biological materials. The spectra are input information for energy deposition studies for neutron microdosimetry and for models of the biological action of neutron radiation.

**13218.** Kirchoff, W. H., Johnson, D. R., **An investigation of centrifugal distortion in the microwave spectrum of formamide,** *J. Mol. Spectrosc.* **45,** No. 1, 159-165 (Jan. 1973).

Key words: Astrophysical interest; centrifugal distortion; formamide; microwave spectrum; quadrupole splittings; rotational transitions; weighted fit.

Measurements of the microwave spectrum of formamide have been extended in order to account accurately for the effects of centrifugal distortion. A total of 22 new transitions involving $J \leq 29$ have been measured for $^{14}NH_2{}^{12}CH^{16}O$ in the ground vibrational state. Combined with previous observations, these transitions have been fit to a model containing five quartic distortion terms and seven sextic terms with an rms deviation of 64 kHz. A large number of resolved quadrupole shifts were fit with an rms deviation of 42 kHz. The remainder of the spectrum for $J \leq 30$ has been calculated with standard deviations less than 3 MHz. Correct weighting of the observed transitions has been found to be important.

**13219.** Oettinger, F. F., Rubin, S., **The use of current gain as an indicator for the formation of hot spots due to current crowding in power transistors,** *Proc. 10th Annual IEEE Reliability Physics Symp., Las Vegas, Nev., Apr. 5-7, 1972,* pp. 12-18 (1972).

Key words: Current gain, hot spot detection; hot spots, current gain as indication of; power transistors, screening; screening for hot spots, transistors; thermal hysteresis, transistors; transistors, hot spot detection.

D-C current gain, $h_{FE}$, measured as a function of collector voltage, with the collector current held constant, is used as a nondestructive screening technique to indicate the formation of hot spots due to current crowding. Its correlation with and advantages over previously used techniques are described. Examples of the use of this technique are presented for a variety of transistor operating conditions.

**13220.** Edwards, J. C., Meijer, P. H. E., **Transition temperatures of systems with mixed ferro and antiferromagnetic coupling,** *Physica* **61,** 67-79 (1972).

Key words: Antiferromagnetism; Bethe constant-coupling; critical temperature; ferromagnetism; Heisenberg model; Ising model; next nearest neighbor interaction.



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To study the influence of a mixture of ferromagnetic and antiferromagnetic couplings on the transition temperature of a spin-1/2 system we used the Bethe or constant-coupling method and applied it to two models: Model A, a system containing two types of atoms with different inter- and intra-spin coupling; Model B, a system which contains two antiferromagnetic sublattices that are ferromagnetically coupled. We find that for reasonable values of the parameters the Curie temperature has the tendency to increase when the antiferromagnetic coupling is present, at least for the models considered using Ising and anisotropic Heisenberg coupling. We also were able to develop an expression, based on Model B, for the critical temperature of a spin-1 system.

**13221.** Prince, E., Finger, L. W., **Use of constraints on thermal motion in structure refinement of molecules with librating side groups,** *Acta Crystallogr.* **B29,** 179-183 (Mar. 1973).

Key words: Constrained refinement; least-squares refinement; molecular crystal structures; molecular libration; rigid-bodies; thermal constraints.

Explicit formulae are derived which express, for molecules consisting of a rigid core to which side groups that are free to librate around a single bond are attached, the second and third cumulants of the scattering density function as functions of molecular translation and libration parameters. These formulae and their derivatives with respect to the molecular motion parameters have been incorporated into a least-squares refinement program which determines directly the values of the position and thermal-motion parameters which give the best fit to the observed data.

**13222.** Prince, E., Schroeder, L. W., Rush, J. J., **A constrained refinement of the structure of durene,** *Acta Crystallogr.* **B29,** 184-191 (Mar. 1973).

Key words: Barrier to rotation; conformation; crystal structure; durene; libration; methylbenzenes, methyl group; molecular structure; torsional oscillation.

The crystal structure of durene (1,2,4,5-tetramethylbenzene, $C_{10}H_{14}$) has been refined from three-dimensional, single-crystal neutron-diffraction data. The crystals are monoclinic, $a=11.57$, $b=5.77$, $c=7.03$ Å, $\beta=112.93°$, space group $P2_1/a$, $Z=2$. A conventional refinement, with anisotropic temperature factors and 485 independent, observed reflections measured with a four-circle diffractometer, gave a weighted residual $R$, on $F$, of 0.085, but the model contained some physically unreasonable thermal parameters. An alternative refinement in which the molecule was constrained to move as a rigid body, but with the methyl groups permitted to librate around the C–C bond, gave a weighted $R$ of 0.115. All differences in position parameters between the two models were small. All carbon atoms and 6 of the 14 hydrogen atoms in the molecule are essentially coplanar. The ring is somewhat distorted, with bond angles at the corners with no methyl groups of about 123° and those at the other corners of about 118.6°. The C–C bond length between two methylated corners is about 1.425 Å, compared with 1.395 Å for the other bonds in the ring. This long bond, combined with C–C–C bond angles of 121.5°, results in adjacent methyl groups being pushed apart. The methyl groups are in an eclipsed conformation. The eigenvectors of the **L** tensor correspond very closely to the axes of principal moments of inertia of the molecule. The hydrogen amplitudes derived from the refinement predict a methyl torsional frequency of 130 $cm^{-1}$, in satisfactory agreement with observed frequencies of 144 and 179 $cm^{-1}$. The whole molecule amplitudes and frequencies derived from the **L** and **T** components of the thermal ellipsoids are also generally consistent with spectroscopic results.

**13223.** Koyama, R. Y., Hughey, L. R., **Angular anisotropies in the photoemission from polycrystalline gold,** *Phys. Rev. Lett.* **29,** No. 22, 1518-1521 (Nov. 27, 1972).

Key words: Emission angle; energy distributions; gold; incidence angle; photoemission; polarization; polycrystalline film; synchrotron radiation.

Measurements of the photoelectron energy distributions from gold indicate angular anisotropies of the emission even for evaporated films. In particular, relative intensities and positions of the *d*-band emission peaks depend on the electron emission angle. We also observe the dependence of the energy distribution on the incidence angle and polarization of the photons.

**13224.** Brown, D. W., Wall, L. A., **High-temperature aging of fluoropolymers,** *J. Polym. Sci.,* Part A-1, **10,** 2967-2982 (1972).

Key words: Degradation; fluoro-elastomer; fluoropolymer; tetrafluoroethylene.

Fluoropolymers including those of 3,3,3-trifluoropropene, 2,3,3,3-tetrafluoropropene, 3,3,4,4,5,5,5-heptafluoropentene-1, and their copolymers with tetrafluoroethylene, were aged in air and in its absence at 225 and 305 °C. Intrinsic viscosities were measured before and after aging. Polymers of high tetrafluoroethylene content are most stable. In air the presence of tertiary hydrogens is associated with lowered stability but the presence of tetrafluoroethylene greatly mitigates this effect. Stress-relaxation studies in air of a vulcanizate of 3,3,3-trifluoropropene and tetrafluoroethylene cured by $\gamma$-rays indicate that the vulcanizate degrades much more rapidly than the untreated polymer.

**13225.** Crannell, H., Hallowell, P. L., O'Brien, J. T., Finn, J. M., Kline, F. J., Penner, S., Lightbody, J. W., Jr., Fivozinsky, S. P., **Electron scattering from low lying $2^+$ states in $^{14}C$,** (Proc. Int. Conf. on Nuclear Structure Studies Using Electron Scattering and Photoreaction, Sendai, Japan, Sept. 12-15, 1972), Paper in *Nuclear Structure Studies Using Electron Scattering and Photoreaction,* K. Shoda and H. Ui, Eds., **5,** 375-384 (Laboratory Report of Nuclear Science, Tohoku University, Tomizawa, Sendai, Japan, 1972).

Key words: Electron scattering; E2 excitations; transition radii; $^{14}C$.

The excitation of levels below 12 MeV in $^{14}C$ has been investigated at the National Bureau of Standards electron scattering facility. The target consists of 50 mg/cm² powdered material enriched to 70 percent in $^{14}C$ contained between 0.025 mm Be foils. Spectra have been obtained for electron energies from 60 to 120 MeV at scattering angles of 92.5, 127.5, and 145 degrees. Levels in $^{14}C$ at 6.09 ($1^-$), 6.59 ($0^+$), 6.73 ($3^-$), 7.01 ($2^+$), 8.32 ($2^+$), 10.43 and 11.35 MeV have been observed.

**13226.** Evenson, K. M., Wells, J. S., Petersen, F. R., Danielson, B. L., Day, G. W., Barger, R. L., Hall, J. L., **Speed of light from direct frequency and wavelength measurements of the methane-stabilized laser,** *Phys. Rev. Lett.* **29,** No. 19, 1346-1349 (Nov. 6, 1972).

Key words: Laser; light; methane-stabilized laser.

The frequency and wavelength of the methane-stabilized laser at 3.39 $\mu$m were directly measured against the respective primary standards. With infrared frequency synthesis techniques, we obtain $\nu=88.376\,181\,627(50)$ THz. With frequency-controlled interferometry, we find $\lambda=3.392\,231\,376(12)$ $\mu$m. Multiplication yields the speed of light $c=299\,792\,456.2(1.1)$ m/sec, in agreement with and 100 times less uncertain than the previously

accepted value. The main limitation is asymmetry in the krypton 6057-Å line defining the meter.

**13227.** Evenson, K. M., Wells, J. S., Petersen, F. R., Danielson, B. L., Day, G. W., **Accurate frequencies of molecular transitions used in laser stabilization: The 3.39-$\mu$m transition in $CH_4$ and the 9.33- and 10.18-$\mu$m transitions in $CO_2$,** *Appl. Phys. Lett.* **22,** No. 4, 192-195 (Feb. 15, 1973).

Key words: $CO_2$ and He-Ne laser frequency; methane; saturated absorption.

The frequencies of three lasers stabilized to molecular absorptions were measured with an infrared-frequency synthesis chain extending upwards from the cesium frequency standard. The measured values are 29.442 483 315(25) THz for the 10.18-$\mu$m $R(30)$ transition in $CO_2$, 32.134 266 891(24) THz for the 9.33-$\mu$m $R(10)$ transition in $CO_2$, and 88.376 181 627(50) THz for the 3.39-$\mu$m $P(7)$ transition in $CH_4$. The frequency of methane, when multiplied by the measured wavelength reported in the following letter, yields 299 792 456.2(1.1) m/sec for the speed of light.

**13228.** Barger, R. L., Hall, J. L., **Wavelength of the 3.39-$\mu$m laser-saturated absorption line of methane,** *Appl. Phys. Lett.* **22,** No. 4, 196-199 (Feb. 15, 1973).

Key words: Interferometry; laser; methane; saturated absorption; wavelength; wavelength standards.

The wavelength of the 3.39-$\mu$m line of methane has been measured with respect to the $Kr^{86}$ 6057-Å standard by using a frequency-controlled Fabry-Perot interferometer. We have exhaustively studied systematic offsets inherent in the experiment, including effects due to asymmetry of the Kr standard line. Lacking a convention relating the defined Kr wavelength 6057.802 105 Å to observables of the krypton line (e.g., center of gravity or fringe maximum intensity point), we report two methane wavelengths: $\lambda_{max\ 1} = 33\,922.314\,04$ Å and $\lambda_{cg} = 33\,922.313\,76$ Å. Both results have an uncertainty of $\delta\lambda = \pm 1.2 \times 10^{-4}$ Å or $\delta\lambda/\lambda = \pm 3.5 \times 10^{-9}$. Multiplication by the frequency measurement of the preceding letter gives the speed of light, $c_{cg} =$ 299 792 456.2(1.1) m/sec.

**13229.** Ely, J. F., Hanley, H. J. M., **Analysis of the viscosity and second virial coefficients of non-polar polyatomic gases using the m-6-8 potential,** *Mol. Phys.* **24,** No. 3, 683-687 (Sept. 1972).

Key words: Nonspherical interactions; polarizability; m-6-8 potential; quadrupole moment; second virial coefficients; viscosity coefficient.

The viscosity and second virial coefficients were calculated for $O_2$, $N_2$, and $CO_2$ using the m-6-8 potential. For the second virial coefficients, the potentials were modified to allow for nonspherical effects by introducing the quadrupole-quadrupole and quadrupole-induced dipole interactions. Independently measured values of the quadrupole moments and molecular polarizabilities were used without changing the spherical parameters as determined by the viscosity coefficients. Agreement between theory and experiment over a wide temperature range is shown to be satisfactory for the viscosity and improved for the second virial coefficients.

**13230.** Pigman, W., Isbell, H. S., **Mutarotation of sugars in solutions: Part I,** Chapter in *Advances in Carbohydrate Chemistry* **23,** 11-57 (Academic Press, Inc., New York, N.Y., 1968).

Key words: Acyclic sugars; anomerization of sugars; kinetics of mutarotation reactions.

This paper is an invited chapter in the annual series "Advances in Carbohydrate Chemistry." The principal facts concerning ring changes and the basis for the mutarotation reactions are reviewed; the basic kinetics are developed and the factors affecting the equilibrium of sugars in solution are discussed. Methods for studying mutarotation reactions are described and the authors' early measurements are summarized.

**13231.** Cook, R. K., **Generation and propagation of sound waves between the ionosphere and the lower atmosphere,** *Conf. Proc. No. 115 on Effects on Atmospheric Acoustic Gravity Waves on Electromagnetic Wave Propagation, Weisbaden, Germany, Apr. 17-21, 1972,* pp. 3-1—3-6 (AGARD of NATO, Neuilly Sur Seine, France, Nov. 1972).

Key words: Auroral; infrasound; ionosphere; microphones; sound waves.

Various physical processes generate sound waves at infrasonic frequencies (oscillation periods > 1.0 sec) in the lower atmosphere. Some typical sources are volcanic explosions, earthquakes, severe storms, and the shock waves from vehicles moving at supersonic speeds. In the ionosphere, sources of infrasound include auroral discharges and shock waves from satellites and meteorites moving at supersonic speeds. We present the results of an analysis for the generation of sound and propagation downwards due to the heating effects of auroral discharges, particularly those traveling at supersonic speeds in directions parallel to the earth's surface. The "shock" waves from such discharges are propagated steeply downward with very little loss of energy from absorption by viscosity and heat conduction, and are frequently observed at infrasonic stations located at high latitudes. An estimate of auroral heating is derived from the observed strengths of infrasound at the earth's surface.

**13232.** Miller, R. C., Kidnay, A. J., Hiza, M. J., **The solid + vapor and liquid + vapor phase equilibrium properties of neon + krypton,** *J. Chem. Thermodyn.* **4,** No. 6, 807-818 (Nov. 1972).

Key words: Krypton; melting line; neon; phase-equilibria.

A vapor-recirculation equilibrium cell was used to investigate the solid + vapor and liquid + vapor equilibria and the three-phase curve (equilibrium between solid, liquid, and vapor) for neon + krypton. Gas phase compositions were measured above solid krypton at 100.00, 110.00, and 115.00 K and at pressures to 95 atm (9.6 MPa). Both gas and liquid phase compositions were determined at 120.00, 130.00, 140.00, and 150.00 K at pressures to 106 atm (10.7 MPa). Comparison of cross second virial coefficients from the experimental gas phase results with values obtained from a corresponding states correlation indicate that a deviation parameter from the geometric mean mixing rule for energy parameters of approximately 0.23 is necessary to reconcile the experimental and predicted virial coefficients. Analysis of the Henry's law constants obtained from the liquid phase results indicates a deviation parameter of approximately 0.21.

**13233.** Weisman, H. M., **Reaching other people's minds through written language,** *Tech. Commun.* **20,** No. 1, 16-19 (1973).

Key words: Human communication; language; meaning; symbols; understanding; written language.

The process of communication is complicated, involving eight variables, and a message must be conveyed through symbols. With such complexity, it seems a wonder that communication ever takes place. By understanding the process, however, communicators may be able to do a better job. This article examines the process in some detail.

**13234.** Hanley, H. J. M., McCarty, R. D., Cohen, E. G. D., **Analysis of the transport coefficients for simple dense fluids: Ap-**

**plication of the modified Enskog theory,** *Physica* **60,** No. 2, 322-356 (Aug. 1972).

Key words: Excess transport property; modified Enskog theory; prediction of transport data; thermal conductivity; transport first density corrections.

The viscosity ($\eta$) and thermal-conductivity ($\lambda$) coefficients for argon, oxygen, and p-hydrogen have been calculated from the modified Enskog theory (i.e., the hard-sphere Enskog theory adapted to include experimental *PVT* data) and compared with experiment over a wide range of experimental conditions. Specifically, experimental data and theoretical predictions for the first density corrections, $\eta_1$ and $\lambda_1$, were examined and the temperature and density dependences of the experimental and theoretical transport coefficients in the liquid were studied. A brief comparison of the modified Enskog with some other theories is included. Overall, the modified Enskog theory, with the exception of the critical region for the thermal conductivity, is found to given reasonable agreement with experiment (to within about 10-15 percent) for densities generally not exceeding twice the critical density.

Qualitatively the theory does not distinguish between the viscosity and thermal conductivity in the liquid. This is discussed by comparing the experimental and theoretical derivatives $(\partial\Delta\eta/\partial T)_\varrho$ and $(\partial\Delta\lambda/\partial T)_\varrho$, where $\Delta\eta$ and $\Delta\lambda$ are excess functions. The qualitative features of the theory are discussed in some detail leading to a method by which the predictive capability of the theory can be improved.

**13235.** Ausloos, P., Rebbert, R. E., Sieck, L. W., Tiernan, T. O., **Experimental evidence for statistical randomization of hydrogen atoms in the ethyl cation,** *J. Amer. Chem. Soc. Communications to the Editor* **94,** No. 25, 8939-8941 (1972).

Key words: Alkyl halides; ethyl cations; 1,2-hydride shift; ion-molecule reactions; ionic structure; photoionization.

It is shown that the hydrogen atoms in the ethyl cations formed in the unimolecular decomposition of $CD_3CH_2I^+$, $CH_3CD_2I^+$, $CD_3CH_2Br^+$, $CD_3CH_2CD_3^+$, $CH_3CD_2CH_3^+$ and $CD_3CH_2CH_2CD_3$ are scrambled statistically at reactant gas pressures ranging from $10^{-5}$ to 1000 torr. Photon absorption (11.6-11.8 eV), electron impact and $^{60}$Co-$\gamma$ radiation have been used in the production of the ethyl cations. Two experimental approaches, kinetic mass spectrometry and chemical end product analysis, have been applied to this problem. The energy barrier for the 1,2-hydride shift in the ethyl cation is shown to be less than 5 kcal/mole.

**13236.** Hummer, D. G., Rybicki, G. B., **The formation of spectral lines,** Chapter in *Annual Review of Astronomy and Astrophysics* **9,** 237-270 (Annual Reviews, Palo Alto, Calif., 1971).

Key words: Plasma diagnostics; radiating gases; radiative transfer; spectral lines; transfer equation.

An introductory survey is given of the current theory of spectral line formation in optically thick systems.

**13237.** Kamper, R. A., **Cryoelectronics,** *Proc. Helium Society Symp., Washington, D.C., Mar. 23-24, 1970,* pp. 68-82 (1970).

Key words: Electronics; low temperature; measurements; superconductivity.

This talk reviews achievements and prospects in the application of superconductivity to electronics and measurement technique. There is a brief introduction to some of the unique properties of superconducting metals at very low temperatures, and a survey of recent developments in the areas of magnetometry, thermometry, infrared technology, amplifiers, switches, low level detectors and voltmeters, and the measurement of fundamental constants. This is an exciting new field in which many researchers have already made impressive achievements.

**13238.** Souders, T. M., **Wide-band two-stage current transformers of high accuracy,** *IEEE Trans. Instrum. Meas.* **IM-21,** No. 4, 340-345 (Nov. 1972).

Key words: Current measurement, audio frequency; current ratio measurement; current transformers, audio frequency; current transformers, precision; transformers, amplifier-aided; transformers audio frequency current; transformers, calibration of; transformers, capacitive error trimming; transformers, precision current; transformers, two-stage current.

The design and performance of two high-accuracy transformers, identified as amplifier-aided two-stage transformers, are described. Each operates from 50 Hz to 10 kHz, supporting burdens up to 1 Ω. Self-contained ratios span from 5/5 to 100/5, with a rated secondary current of 5 A.

Results indicate the errors at 10 kHz are within 30 and 15 ppm for the respective transformers, decreasing to less than 1 ppm at 1 kHz.

Analysis of high- and low-frequency errors is presented, as well as a detailed description of a capacitance trimming technique effecting a factor-of-ten reduction of capacitive errors.

Also described is a relatively simple step-up calibration system for determining the transformer errors. Calibration results are included.

**13239.** Eicke, W. G., Jr., Taylor, B. N., **Summary of international comparisons of as-maintained units of voltage and values of $2e/h$,** *IEEE Trans. Instrum. Meas.* **IM-21,** No. 4, 316-319 (Nov. 1972).

Key words: As-maintained; international comparisons; Josephson effect; $2e/h$ measurements.

Using temperature-regulated transportable standard-cell enclosures, the National Bureau of Standards (NBS), under the auspices of the Bureau International des Poids et Mesures (BIPM), during the period June 1971 through June 1972 has carried out a series of direct comparisons of the units of voltage as-maintained by NBS and BIPM, Sèvres, France; the National Physical Laboratory, United Kingdom; the National Research Council, Canada; the National Standards Laboratory, Australia; and the Physikalisch-Technische Bundesanstalt, Germany. The main purpose of these comparisons was to provide a sound basis for intercomparing values of $2e/h$ obtained at the various national laboratories via the ac Josephson effect in superconductors. It was found that when converted to a common unit of voltage, most measured values of $2e/h$ agreed with each other to within the 1 to 2 parts in $10^7$ estimated uncertainty (1 standard deviation) of the volt comparisons. This satisfying result would seem to indicate that serious consideration should be given to adopting a single international value of $2e/h$ for use in maintaining units of voltage.

**13240.** French, B. M., Walter, L. S., Heinrich, K. F. J., Loman, P. D., Jr., Doan, A. S., Jr., Adler, I., **Compositions of major and minor minerals in five Apollo 12 crystalline rocks,** *NASA Spec. Publ. 306,* 142 pages (National Aeronautics and Space Administration, Washington, D.C., 1972).

Key words: Apollo 12; electron probe analysis; lunar materials; mineral analysis; synthetic standards.

Analytical results are presented on polished thin selections of five Apollo 12 lunar samples. The techniques used are petrographic modal analysis and electron probe microanalysis, including energy-dispersive analysis. Natural minerals and synthetic glasses were used as standards for electron probe analysis.

13241. Hord, J., **Cavitation in liquid cryogens II—Hydrofoil,** *NASA CR-2156,* 157 pages (National Aeronautics and Space Administration, Washington, D.C., Jan. 1973).

Key words: Cavitation; cryogenics; hydrofoil; nucleation; pumps; venturi.

This document constitutes the second of four volumes to be issued on the results of continuing cavitation studies. Boundary layer principles, and two-phase flow concepts, are used to improve existing correlative theory for developed cavity data. Details concerning cavity instrumentation, data analysis, correlative techniques, and experimental and theoretical aspects of a cavitating hydrofoil are given. Both desinent and thermodynamic data, using liquid hydrogen and liquid nitrogen, are reported here. The thermodynamic data indicated that stable thermodynamic equilibrium exists throughout the vaporous cryogen cavities. The improved correlative formulae were used to evaluate these data. A new correlating parameter, based on consideration of mass limiting two-phase flow flux across the cavity interface, is proposed. This correlating parameter appears attractive for future correlative and predictive applications. Agreement between theory and experiment is discussed, and directions for future analysis are suggested. The front half of the cavities, developed on the hydrofoil, may be considered as parabolically-shaped.

13242. Schmidt, A. F., Editor, **ASRDI oxygen technology survey Volume III. Heat transfer and fluid dynamics—abstracts of selected technical reports and publications,** *NASA Spec. Publ. 3076,* 172 pages (National Aeronautics and Space Administration, Washington, D.C., 1972).

Key words: Boiling heat transfer; bubble dynamics; cavitation; condensing heat transfer; correlations; cryogenic fluid safety; fluid dynamics; fluid transfer; heat transfer; heat transfer equipment; liquid helium; liquid hydrogen; liquid nitrogen; liquid oxygen; missiles and rockets; pressurization; radiation heat transfer; spacecraft tankage; stratification; supercritical storage; two-phase flow; zero gravity.

This survey constitutes selected information from an assemblage of reports and publications on Heat Transfer and Fluid Dynamics with direct applicability to oxygen systems. For each document cited, an abstract has been prepared together with key words and a listing of most important references found in the document. Additionally, an Author Index, a Subject Index, and a Key Word Index have been provided to simplify the retrieval of specific information from this work. In each subject area—e.g. Boiling Heat Transfer—the individual citations are listed alphabetically by first author, with review papers dually noted under the appropriate subject category and under Review Papers.

Of the documents reviewed and evaluated for inclusion in this publication, coverage of existing information directly concerned with oxygen was given primary emphasis. However, work not specifically oxygen-designated but considered applicable to oxygen by the reviewer—e.g., a two-phase friction factor correlation derived from nitrogen experiments—is occasionally given where no actual oxygen data exist, as an aid to the reader.

13243. Simmons, J. H., Macedo, P. B., Volterra, V., **Analysis of composition fluctuation lifetimes in a critical oxide mixture by volume relaxation spectroscopy,** *J. Non-Cryst. Solids* **11,** No. 4, 357-367 (Jan. 1973).

Key words: Composition fluctuations; critical point phenomena; immiscibility; oxide glasses; ultrasonic spectroscopy; volume relaxation.

The distribution of volume relaxation times in a critical oxide mixture is calculated from longitudinal and shear modulus measurements. Ultrasonic relaxation allows the investigation of two distinct effects in the distribution of relaxation times as the temperature is lowered toward the critical point. At high temperatures, a coupling between the compressional component of the ultrasonic wave and supercritical fluctuations in composition leads to an anomalous broadening of the distribution of volume relaxation times. This interaction allows a measure of the average composition fluctuation lifetime, $\tau_D$, as a function of temperature. At lower temperatures, as $\tau_D$ becomes longer than the volume relaxation times, the behavior of the distribution follows closely the predictions of an environmental relaxation model proposed by these authors for the analysis of shear relaxation processes in the same material.

13244. Kurylo, M. J., Huie, R. E., **Flash photolysis resonance fluorescence study of the addition of $O(^3P)$ atoms to $C_2H_4$ and $C_2D_4$ at 298 K,** *J. Chem. Phys. Letters to Editor* **58,** No. 3, 1258-1259 (Feb. 1, 1973).

Key words: Ethylene; flash photolysis; kinetics; oxygen atoms; resonance fluorescence.

The flash photolysis resonance-fluorescence technique has been used to measure the rates of the reactions $O + C_2H_4$ and $O + C_2D_4$ at atom concentrations near $10^{11}$ cm$^{-3}$. A computer simulation of the reaction system indicates that at values of $[C_2H_4]/[O] > 1000$ secondary reactions of the O atoms are nonexistent. Under these conditions we confirm our earlier number for $O + C_2H_4$ with $k_1(C_2H_4) = 7.96 \times 10^{-13}$ cm$^3$ molec$^{-1}$ s$^{-1}$ and find $k_1(C_2D_4) = 8.18 \times 10^{-13}$ cm$^3$ molec$^{-1}$ s$^{-1}$. The estimated precision is $\pm$ 10 percent.

13245. Beers, Y., Klein, G. P., Kirchhoff, W. H., Johnson, D. R., **Millimeter wave spectrum of thioformaldehyde,** *J. Mol. Spectrosc.* **44,** No. 3, 553-557 (Dec. 1972).

Key words: Centrifugal distortion; interstellar molecule; millimeter wave spectra; rotational transition thioformaldehyde.

The rotational spectrum of $H_2{}^{12}C^{32}S$ has been investigated in the millimeter region from 100 to 250 GHz. Twenty-five new $R$-branch transitions have been measured and combined with earlier data in a centrifugal distortion analysis of the spectrum. A set of rotational parameters are presented representing the best fit of all available data on the molecule. These rotational parameters allow reliable predictions for all transitions of $H_2{}^{12}C^{32}S$ up to $J = 30$ and $\nu < 300$ GHz.

13246. Melmed, A. J., Carroll, J. J., **Field-ion microscopy of osmium,** *J. Less-Common Metals* **30,** 199-204 (1973).

Key words: Field-ion microscopy; osmium.

Osmium has been successfully imaged in the field-ion microscope using helium ions at temperatures of about 87 K and lower. Specimen preparation procedures and details of image characteristics are described.

13247. Davis, D. D., Herron, J. T., Huie, R. E., **Absolute rate constants for the reaction $O(^3P) + NO_2 \rightarrow NO + O_2$ over the tem-**

**perature range 230-339 K,** *J. Chem. Phys.* **58,** No. 2, 530-535 (Jan. 15, 1973).

Key words: Kinetics; nitrogen dioxide; oxygen atoms; rate constants; stratosphere.

Using the technique of flash photolysis-resonance fluorescence, absolute rate constants have been measured for the reaction $O(^3P) + NO_2 \rightarrow NO + O_2$. Over the temperature range 230-339 K, the rate constant was found to have the value $k$=9.12 $\pm 0.44 \times 10^{-12}$ cm$^3$ molecule$^{-1}$ sec$^{-1}$, independent of temperature. At stratospheric temperatures, this rate constant is about a factor of two faster than indicated from previous measurements.

**13248.** Barrett, R. F., Biedenharn, L. C., Danos, M., Delsanto, P. P., Greiner, W., Wahsweiler, H. G., **The eigenchannel method and related theories for nuclear reactions,** *Rev. Mod. Phys.* **45,** No. 1, 44-108 (Jan. 1973).

Key words: Continuum shell model; nuclear reactions; nuclear structure; photonuclear reactions; $s$-matrix.

The theory of the treatment of particle hole states in the continuum is reviewed with emphasis on the eigenchannel method. The results of actual calculations are compared with experimental data. Some aspects of the experiments are rather well reproduced by the calculations. However, in certain other aspects a qualitative disagreement exists between theory and experiment, pointing to an essential inadequacy of the underlying nuclear model.

**13249.** Roth, R. S., Parker, H. S., Brower, W. S., **Crystal chemistry of lithium in octahedrally coordinated structures. III. A new structure-type in the system $K_2O$:$Li_2O$:$TiO_2$ ($K_xLi_xTi_{4-x/2}O_8$),** *Mater. Res. Bull.* **8,** 327-332 (1973).

Key words: Coordination of $Li^+$ ion; crystal structure; nonstoichiometric phase; system $K_2O$:$Li_2O$:$TiO_2$.

A new compound in the system $K_2O$:$Li_2O$:$TiO_2$ corresponding to the formula $K_xLi_xTi_{4-x/2}O_8$ was found to be orthorhombic with a=3.821, b=15.921, c=2.973A space group Cmcm. The similarity between this unit cell and those of $Rb_xMn_xTi_{2-x}O_4$ and FeO(OH) has been used to predict the structure of this new phase. From the composition of this phase and that of the hollandite and ramsdellite phases in this system, it can be deduced that some of the $Li^+$ ions occur in the tunnels as well as in octahedral coordination substituting for titanium.

**13250.** Waclawski, B. J., Plummer, E. W., **Field emission and photoemission surface studies (Extended Abstract),** *J. Vac. Sci. Technol.* **10,** No. 1, 292 (Jan./Feb. 1973).

Key words: Adsorption; carbon monoxide; field emission; hydrogen; metal surfaces; oxygen photoemission; tungsten.

Since the earliest days of vacuum science, one of the major goals sought by numerous investigators has been the understanding of the nature of the surface bond. Fundamental to this understanding is a determination of the electronic energy levels of a given adsorbate-adsorbent system. Recent advances in experimental techniques show promise of developing a "surface spectroscopy" analogous to the fruitful optical spectroscopy of atoms and molecules. The application of field emission and photoemission to surface spectroscopy has been investigated at NBS for a number of years. Field emission and photoemission electron energy distributions have been measured for tungsten under ultrahigh vacuum conditions and with exposures to gaseous contaminants. The following discussion will illustrate the capabilities, limitations, and complementary features of the techniques.

**13251.** Roth, R. S., Parker, H. S., Brower, W. S., **Comments on the system $Ag_2S$-$In_2S_3$,** *Mater. Res. Bull.* **8,** 333-338 (1973).

Key words: Chalcopyrite-type; silver indium sulfide; spinel-type; wurtzite-type.

The high temperature polymorph of $AgInS_2$ has been found to be orthorhombic with $a$=7.001, $b$=8.278, $c$=6.698Å, space group probably $Pna2_1$ with a distorted wurtzite structure. The phase transition temperature was found to be 620 ± 10 °C and the melting point 880 ± 10 °C. A new cubic spinel type phase was found at the composition $AgIn_5S_8$ with $a$= 10.827Å.

**13252.** Kessler, E. G., Jr., **Determination of the Rydberg constant from the He II $n$ = 3-4 (469-nm) line complex,** *Phys. Rev.* **A 7,** No. 2, 408-415 (Feb. 1973).

Key words: Fine structure; helium; Rydberg constant.

The Rydberg constant has been determined from absolute wavelength measurements on two fine-structure components of the He II $n$=3-4 transition. The He II transition was excited in a liquid-nitrogen-cooled hollow cathode. A pressure-scanned Fabry-Perot spectrometer was used to compare the He II wavelengths with a $^{198}$Hg standard source. The measured value of the Rydberg is $R_\infty$= 109 737.3208±0.0085 cm$^{-1}$, where the uncertainty is one standard deviation.

**13253.** Chang, S. S., **A calorimetric method for studying glass transition in highly crystalline polyethylene,** (Papers Presented at American Chemical Society Meeting, Boston, Mass., Oct. 1971), *Polym. Prepr. Amer. Chem. Soc. Div. Polym. Chem.,* J. E. McGrath, Ed., **13,** No. 1, 322-326 (Apr. 1972).

Key words: Calorimetry; glass transition temperature; partially crystalline polymer; polyethylene; linear and branched; temperature drift method.

A sensitive calorimetric method is employed for the detection of the glass transition phenomena in highly crystalline polymers. This method is based upon the observation of the spontaneous temperature drifts in the glass transition range. The occurrence of the glass transition in a polyethylene sample of 96 percent degree of crystallinity can be demonstrated by this method. Three linear and one branched polyethylene samples were studied. The glass transition in polyethylene is found to occur at 235-240 K.

**13254.** Rasberry, S. D., **Investigation of portable x-ray fluorescence analyzers for determining lead on painted surfaces,** *Appl. Spectrosc.* **27,** No. 2, 102-108 (Mar.-Apr. 1973).

Key words: *In situ* lead detection; lead detection; leaded paint detection; portable lead detectors; portable x-ray fluorescence analyzers.

Four portable x-ray fluorescence analyzers have been examined to ascertain the detection limits and precision with which they can be used for determining lead on painted surfaces. The tests consisted of using the analyzers to determine the weight of lead present (mg/cm$^2$) on each of several substrates which had been coated with weighed quantities of paints of known composition. All of the instruments tested had detection limits lower than 1.0 mg/cm$^2$. In some measurements, where lead was present between 1.0 and 6.6 mg/cm$^2$, errors as large as 30 to 50 percent occurred; thus, it was concluded that the portable analyzers tested would be useful mainly for screening painted walls for high lead levels.

**13255.** Geist, J., Zalewski, E., **Chinese restaurant nomenclature for radiometry,** *Appl. Opt.* **12,** No. 2, 435-436 (Feb. 1973).

Key words: Geometrical radiative transfer; nomenclature; optical radiation; phluometry; photometry; radiometry; terminology.

A new nomenclature system for radiometry is proposed.

**13256.** Caswell, R. S., Coyne, J. J., **Secondary particle spectra produced by neutron interactions with tissue,** *Proc. 1st Symp. on Neutron Dosimetry in Biology and Medicine, Neuherberg/Munchen, Germany, May 15-19, 1972*, **1, EUR 4896 d-f-e,** 25-41 (Commission of European Communities, Luxenbourgh, Germany, Sept. 1972).

Key words: Energy deposition; neutron dosimetry; secondary particle spectra; tissue.

Some basic aspects of neutron interactions with tissue are discussed: energy transfer to matter according to element present in the tissue and by type of charged particle produced; calculations of secondary particle spectra produced when neutrons interact with tissue for 1 and 14 MeV neutron energy. Both the primary spectra of secondary particles as produced in the nuclear reactions, and the softer "slowing-down" or "equilibrium" spectra after particle slowing down are determined. The relative importance of the various secondaries (p, d, $\alpha$, Be, B, C, N, O) are discussed. These spectra provide physical input information for calculations of neutron energy deposition (examples given) and for models of neutron radiation effects on biological materials.

**13257.** Waterstrat, R. M., **The vanadium-platinum constitution diagram,** *Met. Trans.* **4,** 455-466 (Feb. 1973).

Key words: Alloys; constitution diagram; equilibrium diagram; phase diagram; platinum; vanadium.

The system V-Pt was investigated over the entire composition range by metallography, x-ray diffraction and electron microprobe studies. There are at least four equilibrium intermediate phases in this system and they are stable to progressively higher temperatures with increasing vanadium concentration. The phases which have been observed are: $\gamma'$, cubic, $Cu_3Au$ type; $\theta$, tetragonal, $TiAl_3$ type; $\delta$, orthorhombic, $MoPt_2$ type; $\zeta$, orthorhombic, AuCd type; and $\beta$, cubic, $Cr_3Si$ type (A15). The $\gamma'$ phase is possibly metastable. A very stable ribbon-like growth of $\zeta$ phase in the fcc platinum terminal solid solution has been observed in alloys containing about 43 at. pct V. The platinum terminal solid solution forms a congruent melting maximum at about 1805 °C. A eutectic reaction occurs at $1720 \pm 10$ °C and a peritectic reaction is indicated at $1800 \pm 10$ °C. Vanadium is soluble in the fcc platinum terminal solid solution up to about 57 at. pct at 1720 °C. Platinum dissolves only to the extent of about 12 at. pct at 1800 °C in bcc $\alpha$-V.

**13258.** Mies, F. H., **Molecular theory of atomic collisions: Fine-structure transitions,** *Phys. Rev. A* **7,** No. 3, 942-957 (Mar. 1973).

Key words: Atomic collisions; fine-structure transitions; $HF^+$ molecule; molecular states; quantum chemistry.

The theory of fine-structure transitions in atom-atom collisions is formulated in terms of the molecular states of the diatomic collision complex. The Born-Oppenheimer (BO) electronic wave functions are implicit functions of the interatomic coordinate $R$, and the molecular theory is analogous to the "perturbed-stationary-state" method. Expansion in *molecular* channel states incorporates the effects of polarization, exchange, and valence forces on the electronic portion of the scattering wave function and embodies the "adiabatic" contribution of the entire set of closed-channel excited states that are generated in the more usual asymptotic-atomic-state expansion. The channel states are expressed explicitly in terms of the body-fixed molecular wave functions, and the resultant interaction matrix elements in the close-coupling scattering formalism are related to the molecular potentials. The theory is developed specifically for proton collisions with the fluorine atom in its ground $^2P_{j,mj}$ state, with explicit account being taken of the spin-orbit splitting between the $j=3/2$ and $j=1/2$ multiplet states. Use is made of the accurate $HF^+(^2\Pi)$ and $HF^+(^2\Sigma)$ wave functions calculated by Wahl, Julienne, and Krauss. These molecular states asymptotically approach $H^+ + F(^2P)$, and accurate quadrupole and induced-dipole interaction parameters which describe the asymptotic interaction potentials are obtained from the calculations. Estimates are made of the BO coupling terms and they are found to be negligible compared to the spin-orbit couplings. In the following paper close-coupling calculations are made of the cross sections for the fine-structure transitions $(j,m_j \rightarrow j',m_j)$.

**13259.** Paffenbarger, G. C., Rupp, N. W., **Research techniques used in evaluating dental materials,** *J. Amer. Dent. Ass.* **86,** 643-651 (Mar. 1973).

Key words: Biological; chemical; physical; reliable; specification; use; valid.

Evaluation of dental materials is an exact science that is dependent on several disciplines to be effective. Physical, mechanical, chemical, biological and clinical or user tests must be coordinated with maximum and/or minimum values for each evaluation. In the acceptance of a material for use in dentistry each of these areas must be accurately defined. Then for specifications prescribing the quality of a material the pertinent or relevant properties are determined and tests established to measure these characteristics. The design of suitable specification tests that are both reliable and valid is no mean research task. By reliable it is meant that a test can be repeated satisfactorily by different laboratories. By valid is meant that the tests will predict the behavior of the materials in service. These tests of necessity must provide answers quickly within days as compared to years in service, thus are often abusive in nature. Silicate cements and acrylic resins are two materials used to illustrate various tests and their development.

**13260.** Loebenstein, W. V., **Heats of adsorption of ammonia and carbon dioxide on tooth components,** *J. Dent. Res.* **51,** No. 6, 1529-1536 (Nov.-Dec. 1972).

Key words: Adsorption; ammonia adsorption; carbon dioxide adsorption; dental adhesive; dentin; heats of adsorption; surface area.

The study demonstrates how heats of adsorption and area of coverage can be used as criteria for comparing the ultimate strength of chemically reactive groups for incorporation in potential dental adhesives. Carbon dioxide and ammonia were chosen as the reactants because they typified acidic and basic groups, respectively, and were both gases. Measurements were confined to the region of reversible adsorption in order to assure reproducibility of the adsorbent surface. The presence of collagen exerted a profound influence on the BET area depending upon the gas used when compared with nitrogen. Ammonia exhibited a higher surface area as well as a higher heat of adsorption on dentin than did carbon dioxide. It would therefore qualify as a better adhesive under the conditions of comparison. The surface area of dentin available to ammonia, however, was no greater than the surface area of anorganic dentin. The average heat of adsorption of ammonia on anorganic dentin based on anorganic whole teeth is estimated to be at least as large as it is for whole dentin. Thus, it would appear that the presence of collagen did not contribute to the adhesive strength of ammonia.

**13261.** Paffenbarger, G. C., **The role of dental materials in the prevention of dental diseases,** *Int. Dent. J.* **22,** No. 3, 343-349 (Sept. 1972).

Key words: Caries; dental materials; plastics; prevention; sealants; tooth loss.

The permanent tooth loss per hundred of 13 year olds averaged 6 for Norwegians and 100 for Americans because of early treatment of caries of the Norwegians with dental restorative materials.

Recurrent caries occurs less frequently around restorations of silicate cement than around any other restorative material. The same holds for caries of surfaces of adjacent teeth in contact with silicate cement restorations. The anticariogenic effect is probably caused by the transfer of fluoride ions to the dental enamel, thereby rendering it less soluble. Newly developed plastic formulations appear to seal developmental defects in teeth so as to greatly retard dental caries which so frequently occurs at such sites.

Recurrent caries around restorations should be reduced if a chemical bond of the tooth-filling interface could be achieved. Promising developments are available.

**13262.** Hougen, J. T., **Reinterpretation of molecular beam hyperfine data for $^{14}NH_3$ and $^{15}NH_3$,** *J. Chem. Phys.* **57,** No. 10, 4207-4217 (Nov. 15, 1972).

Key words: Centrifugal distortion; hyperfine structure; inversion doublet; molecular beam; $NH_3$; quadrupole splitting.

Reassignments are presented for the hyperfine patterns of six $^{15}NH_3$ inversion doublets. The new assignments alter the sign of the nitrogen-hydrogen spin-spin interaction constant. Previous disagreement between theory and experiment for the hyperfine pattern of the $J=3$, $K=2$ $^{14}NH_3$ inversion doublet is removed by including the effect of centrifugal distortion on the quadrupole splitting. An explanation is presented for a discrepancy remaining in the fit of the $J=K=6$ hyperfine pattern of $^{15}NH_3$.

**13263.** Seltzer, S. M., Berger, M. J., **Photoneutron production in thick targets,** *Phys. Rev. C* **7,** No. 2, 858-861 (Feb. 1973).

Key words: Bremsstrahlung; Monte Carlo; neutron yield; photonuclear cross sections; photoneutrons; radiation transport.

This paper reports new results on the yield of photoneutrons from thick targets bombarded with electron beams. Yields have been calculated for incident electron energies from 20 MeV down to the photonuclear cross section threshold, for tantalum and tungsten targets with thicknesses up to 12.5 gcm$^{-2}$. The increased yield from composite tungsten-beryllium targets has been explored.

**13264.** Chen, C. L., Phelps, A. V., **Absorption coefficients for the wings of the first two resonance doublets of cesium broadened by argon,** *Phys. Rev. A* **7,** No. 2, 470-479 (Feb. 1973).

Key words: Absorption coefficient; argon; broadening; cesium; resonance lines.

Measurements are reported of the absolute absorption coefficients in the wings of the 8944-, 8521-, 4593-, and 4555-Å resonance lines of cesium in the presence of argon at densities between about $6\times10^{18}$ and $2\times10^{19}$ atom cm$^{-3}$. The data extend from about 0.7 Å to as much as 600 Å from the line center and were obtained using cesium densities between $7\times10^{11}$ and $2\times10^{15}$ atom cm$^{-3}$ and temperatures between 390 and 470 °K. The measured absorption coefficients are proportional to the product of the cesium and argon densities as expected from line broadening produced by binary collisions between cesium and argon atoms. Using the quasistatic theory as a guide for interpretation, the line profiles for wings of the first resonance doublet show a transition from a wavelength dependence determined by long-range van der Waals forces to a dependence determined by the short-range internuclear potentials discussed by Hedges, Drummond, and Gallagher (HDG). The far-wing absorption profiles obtained in the present experiments are in good agreement with those calculated from the fluorescence data of HDG.

**13265.** Greer, S.C., **The $CH_4$-Kr solid phase diagram,** *Phys. Lett.* **43A,** No. 1, 73-74 (Feb. 12, 1973).

Key words: Crystal structure; krypton; methane; mixture, binary solid.

X-ray diffraction studies on solid mixtures of $CH_4$ and Kr show complete miscibility on a face-centered cubic lattice from 21K to the melting curve.

**13266.** Costrell, L., **CAMAC: A review and status report,** (Proc. Symp. on Nuclear Science, Miami, Fla., Dec. 8, 1972), *IEEE Trans. Nucl. Sci.* **NS-20,** No. 1, 557-561 (Feb. 1973).

Key words: CAMAC; computer interfacing; control systems; instrumentation; instrumentation standards; nuclear instrumentation; standards.

CAMAC is a modular instrumentation system for transmission of digital data between instruments and between instruments and computers and computer peripherals. The system is described in a general way and the history of the CAMAC development, its expanding utilization in various fields and its current status are discussed. This is an introductory paper delivered at the 1972 Nuclear Science Symposium and is followed by papers that discuss CAMAC in greater detail.

**13267.** Horn, W. A., **Some fixed point theorems for compact maps and flows in Banach spaces,** *Trans. Amer. Math. Soc.* **149,** 391-404 (June 1970).

Key words: Asymptotic fixed point theorems; Banach space; compact mappings, fixed points; flows; nonejective fixed points; nonrepulsive fixed points.

Let $S_0 \subset S_1 \subset S_2$ be convex subsets of the Banach space $X$, with $S_0$ and $S_2$ closed and $S_1$ open in $S_2$. If $f$ is a compact mapping of $S_2$ into $X$ such that $\cup_j^m = 1 f^j(S_1) \subset S_2$ and $f^m(S_1) \cup f^{m+1}(S_1) \subset S_0$ for some $m > 0$, then $f$ has a fixed point in $S_0$. (This extends a result of F. E. Browder published in 1959.) Also, if $\{T_t : t \in R^+\}$ is a continuous flow on the Banach space $X$, $S_0 \subset S_1 \subset S_2$ are convex subsets of $X$ with $S_0$ and $S_2$ compact and $S_1$ open in $S_2$, and $T_{t_0}(S_1) \subset S_0$ for some $t_0 > 0$, where $T_t(S_1) \subset S_2$ for all $t \leqq t_0$, then there exists $x_0 \in S_0$ such that $T_t(x_0) = x_0$ for all $t \geqq 0$. Minor extensions of Browder's work on "nonejective" and "nonrepulsive" fixed points are also given, with similar results for flows.

**13268.** Stromberg, R. R., McCrackin, F. L., **Ellipsometry as a tool for the characterization of surfaces,** (Proc. Symp. on Clean Surfaces: Their Preparation and Characterization for Interfacial Studies, North Carolina State University, Raleigh, N.C., April 1968), Chapter in *Clean Surfaces: Their Preparation and Characterization for Interfacial Studies,* G. Goldfinger, Ed., pp. 65-76 (Marcel Dekker, Inc., New York, N.Y., 1970).

Key words: Characterization surface; ellipsometry; interfacial studies; optical constants; polarization of light; reflectivity.

The application of ellipsometry to the characterization of surfaces is discussed. The technique is very sensitive and is applicable to the detection of very thin contaminating films. It is often possible to characterize a surface under the same conditions required for further interfacial studies of the surface. The sensitivity of the method and the dependence of this sensitivity on

factors such as refractive index differences, angle of incidence, and number of reflections are discussed relative to the problem of surface characterization and detection of contaminating films. The technique is not limited to highly reflecting surfaces and its applications to studies of surfaces of transparent materials are also described.

**13269.** Zimmerman, J. E., **A review of the properties and applications of superconducting point contacts,** *Proc. Conf. Applied Superconductivity, Annapolis, Md., May 1-3, 1972,* pp. 544-561 (IEEE, Inc., New York, N.Y., 1972).

Key words: Josephson effect; point contacts; superconductivity.

Superconducting small-area ("point") contacts are easily made in a number of forms, and are used in a wide variety of devices, some of which are quite highly evolved. For many practical purposes no special contact surface preparation is required. Electrical properties are often said to be "tunnel-junction like" or "metal-bridge like," but the meaning of these terms is not clear. New evidence shows that perfectly-clean metallic contacts often exhibit all the features expected of low-capacitance tunnel junctions. Permanently-stable point-contact devices have been made by one or a combination of several techniques, but their vulnerability to electrical and other transients has led to the development of simple and effective adjusting mechanisms. Certain point contacts, with minimum possible shunt capacitance and shunt normal conductance, approach the ideal of pure Josephson current elements ($i = i_c \sin \theta$) more closely than any other type of Josephson junction, and, for this reason, appear to be the best type of junction for millimeter-wave and far-infrared applications. Paradoxically, the dc-IV characteristics of such pure Josephson elements can be very complex if they are closely coupled to external circuit elements such as microwave cavities and resonances of impurity molecules.

**13270.** Kaldor, A., Maki, A. G., Dorney, A. J., Mills, I. M., **The assignment of $\nu_2$ and $\nu_4$ of $SO_3$,** *J. Mol. Spectrosc.* **45,** No. 2, 247-252 (Feb. 1973).

Key words: Air pollution; infrared spectra; molecular structure; Raman spectra; spectra; sulfur trioxide.

Three experiments have been performed to resolve an uncertainty in the assignment of $\nu_2$ and $\nu_4$ for $SO_3$: (i) the gas phase Raman spectrum has been measured; (ii) the infrared active combination band $\nu_3 + \nu_4$ has been measured; (iii) a band contour calculation has been performed taking account of the *l*-type resonance in $\nu_4$ and a strong Coriolis resonance between $\nu_2$ and $\nu_4$. These experiments establish beyond any doubt that $\nu_2$ lies at about 497.5 $cm^{-1}$ and $\nu_4$ lies at about 530.2 $cm^{-1}$. The contour calculation also shows that the Coriolis resonance gives rise to a positive intensity perturbation.

**13271.** Das, E. S. P., Marcinkowski, M. J., Armstrong, R. W., de Wit, R., **The movement of Volterra disclinations and the associated mechanical forces,** *Phil. Mag.* **27,** No. 2, 369-391 (Feb. 1973).

Key words: Disclination; dislocation; glide; plasticity; twist; Volterra; wedge.

An analysis is made of conservative and non-conservative movement of Volterra disclinations and the associated mechanical forces. It is shown that both disclination lines and their axes can experience a force under the action of an applied stress. A general equation is derived for the force on a disclination loop and its axis. The condition for conservative movement is derived. Examples illustrating these principles are given. Glide surfaces for disclination loops are defined. The motion is conservative on a surface generated by rotating the disclination line around its axis, and on a plane normal to the axis. It is shown how a twist loop can be converted to a wedge loop and, *vice versa*, conservatively.

**13272.** Meijer, P. H. E., Niemeijer, Th., **Search for the ground state of cerous magnesium nitrate by an extended Luttinger-Tisza method,** *Phys. Rev. B* **7,** No. 5, 1984-1988 (Mar. 1, 1973).

Key words: Antiferromagnetism; cerium magnesium nitrate; digital representation; dipole-dipole interaction; ground state; Luttinger-Tisza method; neodimium magnesium nitrate; superlattice.

The ground state of cerous magnesium nitrate is determined using the assumptions that the spins are coupled by purely dipolar forces, the magnetic structure is periodic after eight or less lattice periods, and the spins can be considered as classical vectors. The ground state has a layered antiferromagnetic structure as described in the text. A study is made to see whether this result is dependent on the assumption that the $g$ factor parallel to the crystallographic $c$ axis is zero or almost zero for this specific salt. The conclusion is that this is to a large extent not the case. The ground state lies at an energy $-1.867$ mdeg K, using the lattice constants as given by Schiferl.

**13273.** Mies, F. H., **Molecular theory of atomic collisions: Calculated cross sections for $H^+ + F(^2P)$,** *Phys. Rev. A* **7,** No. 3, 957-967 (1973).

Key words: Atomic collisions; fine-structure transitions; $HF^+$ molecule; molecular states; quantum chemistry.

The results of a close-coupling calculation of the fine-structure transitions $(j, m_j \rightarrow j', m_j')$ are presented for collisions between photons and $F(^2P_{j,m_j})$. The theory is formulated in the perturbed-stationary-state approximation using accurate molecular wave functions for the ground $^2\Pi$ and $^2\Sigma$ states of $HF^+$. Comparison is made to the predictions of the Born approximation. The magnetic selection rule $(j, m_j \rightarrow j, -m_j)$ is strongly violated in the $j = 3/2$ state and less strongly violated in the $j = 1/2$ state. It is concluded that the important region of interaction for the $j = 1/2 \rightarrow j = 3/2$ transition is at short-to-intermediate distances where accurate molecular potentials are required and close-coupling effects are dominant.

**13274.** Bennett, J. J., Holman, M. A., Tumarkin, J. E., **The economic impact of noise,** *Environmental Protection Agency Report No. NTID 300.14,* 104 pages (available as PB206726 from the National Technical Information Service, Springfield, Va. 22151, Dec. 31, 1971).

Key words: Economic impact of noise; noise abatement.

A study has been undertaken to survey the economic impact of noise. Data available on the entire subject of noise and its abatement are so rudimentary that they do not lend themselves to even the most primitive economic analysis. It is demonstrated that the number of sources of noise in homes, in industry, on the highways, and in the air is growing at a dramatic rate. These noise sources are heterogeneous and transient, and therefore, a universal solution for abatement of noise at the source is not available. From the economic viewpoint, it has been demonstrated that substantial costs are associated with noise and its abatement. Costs such as those associated with equipment redesign, right-of-way, and receiver insulation are discussed in detail. The most glaring data gaps highlight the need for research into the relationship between noise, its abatement, and its impact on: wages, prices, productivity, production costs, employment, balance of payments, real property values, and health. Research

using the principles of economics must identify and analyze the most cost-effective alternative solutions to noise. A discussion of spending for noise research is included in the study.

13275. Christ, B. W., Smith, L. C., **A chemical polish for quick removal of grinding and lapping scratches from iron and low-carbon steel,** *J. Iron Steel Inst. Tech. Note*, p. 155 (Feb. 1973).

Key words: Chemical polish; iron; low-carbon steel; single phase alloys; swabbing.

The composition and use of a chemical polish for iron and low-carbon steel is described. Swabbing metallographic samples with this polish completely removes scratches left by 600 grit silicon carbide in about 5 seconds. Furthermore, the polished surfaces are flat enough for grain size analysis via optical microscope observation.

13276. Cezairliyan, A., Beckett, C. W., **Pulse calorimetry of solids at high temperatures,** Chapter 6 in *Thermochemistry and Thermodynamics*, H. A. Skinner, Ed., **10,** 159-175 (Butterworths, London, 1972).

Key words: Measurements at high temperatures; millisecond resolution; pulse calorimetry; solid electrical conductors.

Pulse techniques for the measurement of specific heat of solid electrical conductors at high temperatures are described. Design and operational characteristics of pulse calorimetric systems reported in the literature are summarized. Details of an accurate millisecond resolution pulse calorimeter are given.

13277. Marshall, H. E., **Cost sharing and multiobjectives in water resource development,** *Water Resour. Res.* **9,** No. 1, 1-10 (Feb. 1973).

Key words: Cost allocation; cost sharing; environmental quality; efficiency; equity; multiobjectives; multi-purpose projects; regional development; water policy; water resources.

The U.S. Water Resources Council has considered objectives in addition to national economic development for the evaluation of water projects. Cost-sharing rules have not been proposed for the new objectives. A conceptual method is proposed for planning the nationally optimal project with multiobjectives. The data required for project evaluation with multiobjectives are used to apply a cost-sharing rule that induces local interests to choose nationally efficient projects. The rule is recommended for traditional project purposes and some new purposes. It can be applied to a multiple-purpose project without allocating project joint costs. A ceiling and a floor on local percentage cost shares of 100 percent and 20 percent of project costs, respectively, are considered for traditional purposes. Local percentage cost shares of 50 percent and 100 percent are considered for all costs allocated to environmental quality and regional development objectives, respectively.

13278. Radebaugh, R., Frederick, N. V., Siegwarth, J. D., **Flexible laminates for thermally grounded terminal strips and shielded electrical leads at low temperatures,** *Cryogenics* **13,** No. 1, 41-43 (Jan. 1973).

Key words: Cryostat; laminate; photoetching; thermal grounding; transmission line.

It is shown how to make compact, thermally grounded terminal strips for electrical leads in cryostats from flexible electrical laminates composed of copper foil bonded to a polyimide film. Laminates of lead foil and polyimide film are used to make a superconducting strip line, a type of transmission line in which it is easy to thermally ground both conductor and shield. The thermal resistance across a laminate was measured between 0.02 and 4 K from which the thermal conductivity of polyimide film is deduced between 0.1 and 4 K.

13279. Danos, M., Greiner, W., Rafelski, J., **Fields nonlocal in Clifford space. I. Classical gauge-invariant nonlinear field theory,** *Phys. Rev. D* **6,** No. 12, 3476-3491 (Dec. 15, 1972).

Key words: Fermion-boson interactions; field theory; gauge invariance; hypercomplex coordinates; interacting fields; nonlinear field theory; nonlocal field theory.

A fully gauge-invariant, Lorentz-covariant, nonlocal, and nonlinear theory, for coupled spin-1/2 fields, $\psi$, and vector fields, $A$, i.e., "electrons" and "photons," is constructed. The field theory is linear in the $\psi$ fields. The nonlinearity in the $A$ fields arises unambiguously from the requirement of gauge invariance. The coordinates are generalized to admit hypercomplex values, i.e., they are taken to be Clifford numbers. The nonlocality is limited to the hypercomplex component of the coordinates. As the size of the nonlocality is reduced toward zero, the theory goes over into the inhomogeneous Dirac theory. The nonlocality parameter corresponds to an inverse mass and induces self-regulatory properties of the propagators. It is argued that in a gauge-invariant theory a graph-by-graph convergence is impossible in principle, but it is possible that convergence may hold for the complete solution, or for sums over classes of graphs.

13280. Armstrong, G. T., **Some current topics in thermochemistry and calorimetry at the National Bureau of Standards,** *Proc. Colloq. Int. de Thermochimie, Marseille, France, June 30-July 2, 1971,* No. 201, 77-96 (Centre National de la Recherche Scientifique, Colloques Internationaux, Paris, France, 1972).

Key words: Calorimetry, flow; calorimetry, solution; chlorine monofluoride; fluorine dissociation; hydrofluoric acid solution calorimetry; microcalorimetry; quartz, standard reference materials; standard reference material for calorimetry.

The current program of the Thermochemistry Section at the National Bureau of Standards includes approximately equal proportions of experimental research and data compilation and evaluation activities. Experimental studies of calorimetric accuracy, reference materials for calorimetry, and the properties of selected key substances are in progress. The enthalpy of solution in aqueous hydrofluoric acid (24.4 percent and other concentrations) at 80 °C and as a function of temperature has been determined for $\alpha$-quartz to permit its issuance as a reference material for mineralogical calorimetry. A Calvet microcalorimeter has been placed in operation with digital data-logging accessories with a sensitivity of about 0.1 $\mu$W. It has been shown to operate effectively in a temperature-scanning mode. Flow calorimetry using the reaction:

$$\left[ClF_n(g) + \left(\frac{n+1}{2}\right) H_2(g) + m\,H_2O(l) = [HCl + n\,HF + m\,H_2O]\,(l)\right]$$

has led to enthalpies of formation of ClF, $ClF_3$ and $ClF_5$. The binding energy per atom in the gaseous molecules varies only from 128.0 to 122.3 kJ $mol^{-1}$ in the series. The enthalpy of formation of ClF provides some (inconclusive) evidence that the zero point dissociation energy of fluorine is less than 153.8 kJ $mol^{-1}$. Other experimental programs are also active but are not covered here.

13281. Barnett, J. D., Block, S., Piermarini, G. J., **An optical fluorescence system for quantitative pressure measurement in the diamond-anvil cell,** *Rev. Sci. Instrum.* **44,** No. 1, 1-9 (Jan. 1973).

Key words: Diamond-anvil cell; fluorescence; pressure measurement; ruby.

An optical system for rapid routine pressure measurement is described which utilizes a pressure shift in the sharp $R$-line fluorescence spectrum of ruby or similar materials. The system, which consists of a standard polarizing microscope and a 1/4 m monochromator with associated photodetection system, is used with the diamond-anvil pressure cell, but can be employed with suitable modification in any pressure system which has optical access. The precision of the pressure measurement in a hydrostatic environment up to 100 kilobar is 0.5 kilobar using ruby as the pressure sensor. This precision is better than the accuracy of the present pressure scale above 40 kilobar. The merits of fluorescent materials other than ruby as pressure sensors are also discussed. A description of a Waspaloy diamond cell with some modifications in design is given. This improved cell and associated techniques extends the pressure range in gasketed systems up to 200 kilobar at room temperature and to moderate pressures at 700 °C.

**13282.** Horn, W. A., **Determining optimal container inventory and routing,** *Transp. Sci.* **5,** No. 3, 225-231 (1971).

Key words: Containers; inventory; network flows; optimal container routing; optimal routing; routing in a network.

Generalizing work of Samuel and Ullmann, this paper shows how to determine the optimal number and routings of containers used to move mail among several cities. Critical assumptions are (a) periodic demand patterns and linear transportation costs (for full or empty containers, or uncontainerized mail) between each city-pair, and (b) constant fixed cost per container in the system. The optimization problem is transformed into a network flow linear program for which efficient solution methods are known.

**13283.** Garvin, D., **Critical data for the physical sciences,** (Papers Presented to the Council of Biology Editors, Carleton University, Ottawa, Canada, May 11, 1970), *CBE Newsletter,* pp. 6-11 (Sept. 1970).

Key words: Chemistry; critical data; evaluation of delay; information analysis; publication standards; standard reference data.

The subject of this paper is critical data in the physical sciences. The topic is a broad one; only a few aspects can be discussed, those of current interest. The topic is also diffuse and difficult to define. The term "critical data" is a technical term and is misleading. What we are concerned with is "reliable data," that is, data that may be used with confidence in planning experiments, reducing results and interpreting phenomena. The term "critical data" is used in the sense of criticism; review, selection, comparison and recommendation. This is part of the process of providing a discipline with that large body of information, in readily accessible form, upon which it must build.

**13284.** Maienthal, E. J., **Determination of trace elements in silicate matrices by differential cathode ray polarography,** *Anal. Chem.* **45,** No. 4, 644-648 (Apr. 1973).

Key words: Alloys; analyses; cast irons; differential cathode ray polarography; high-purity materials; metals; steels; trace elements.

Methods are described for the analysis of some new Trace Elements in Glass Standard Reference Materials by differential cathode ray polarography. Iron and titanium were determined in the 500-, 50-, 1-, 0.02-ppm and base glasses after cupferron and ammonium hydroxide separations. Nickel was determined in the 500- and 1-ppm samples after extraction with dimethylglyoxime.

**13285.** Hagan, L., **Reports of observatories for 1971/72, National Bureau of Standards, Washington, D.C.,** *Bull. Amer. Astron. Soc.* **5,** No. 1, Part II, 201-204 (Jan. 1973).

Key words: Atomic energy levels; atomic line shapes; atomic spectra; atomic transition probabilities; bands, molecular; energy levels, atomic; line shapes, atomic; molecular bands; molecular spectra; rotational constants.

Research at the National Bureau of Standards in spectroscopy pertinent to astronomy is summarized. Publications on atomic spectra, atomic transition probabilities and line broadening, and molecular spectra are referenced and work in progress is discussed.

**13286.** Hall, J. L., **The lineshape problem in laser-saturated molecular absorption,** Paper in *Lectures in Theoretical Physics,* K. T. Mahanthappa and W. E. Brittin, Eds., **XII,** 161-210 (Gordon and Breach. Sci. Publ. Inc., New York, N.Y., Mar. 1973).

Key words: Absorption; laser; molecular; saturation.

The use of lasers makes it possible to observe non-linear optical absorption in molecules. Experiments involving two running waves represent a particularly interesting case, as they allow observation of a very sharp "emission" feature when the radiation frequency matches the natural molecular absorption frequency. This resonance feature has a width characteristic of *natural* rather than Doppler broadening. This paper presents a physical discussion of the main features of the saturated absorption process, with particular emphasis on realistically representing inherent experimental conditions as they affect the mathematical formulation. In a certain approximation, one finds a power-broadened Lorentzian lineshape, in agreement with a fairly broad class of experimental results. A pair of coupled differential equations is derived which should represent the lineshape under more general conditions. The saturation process provides a selection mechanism *against* particles which experience a collision during their coherent interaction with the radiation. The implications of this effect for laser collision physics experiments are examined in some details.

**13287.** Krauss, M., **Energy surfaces for energy transfer and chemical reaction,** *Proc. IBM Scientific Computing Symp. on Computers in Chemistry, Poughkeepsie, N.Y., October 6-17, 1968,* pp. 65-76 (1969).

Key words: *Ab initio* calculations; HF approximation; schematic mechanism; simple prototypes.

The calculations described are an indication of the possibilities of *ab initio* calculations. They provide the necessary data for an accurate scattering calculation or a test of a schematic mechanism deduced from experiment. For carefully chosen systems, the HF approximation is sufficient and the present results point to obviously analogous systems, for which these results would be useful. The extent to which this is done depends almost entirely on the cost. Table I gives the time on an IBM 7094-I for a representative point on the surface depicted herein. The systems are simple prototypes, and the extension to larger, more practicable ones would considerably increase the times. This is especially true for the correlated calculations which must be seriously considered for the general problem. But the present results and those from many other sources would strongly indicate that it is very worthwhile to spend the effort required to adapt these problems to the new generation of computers.

**13288.** Kurylo, M. J., Peterson, N. C., Braun, W., **Absolute rates of the reactions $H + C_2H_4$ and $H + C_2H_5$,** *J. Chem. Phys.* **53,** No. 7, 2776-2783 (Oct. 1, 1970).

Key words: Ethyl radicals; ethylene; hydrogen atoms; kinetics; resonance fluorescence.

The hydrogen atom-ethylene system was studied at 298 K employing the methods of resonance fluorescence and absorption by hydrogen atoms of Lyman $\alpha$ radiation at 1216 Å. The contribution of hydrogen atom-radical reactions was evaluated under varying experimental conditions, and the rate of disappearance of H atoms in ethylene was measured under conditions where stoichiometric corrections became significant. Measurements in the literature of reaction rates for $H + C_2H_4$ at low total pressure are now in good agreement; however the limiting high-pressure absolute rate constants thus far reported differ depending on the assignment of stoichiometric factors. Our results indicate that stoichiometric factors obtained under low-pressure conditions may not be applicable to high pressure. Furthermore, extrapolations based on plots of inverse rate constant vs inverse pressure may be in error due to significant curvature in such plots. Our high-pressure limiting rate constant for $H + C_2H_4$, extrapolated from data at pressures higher than those used by other workers, is free to stoichiometric corrections and is in agreement with our earlier measurements. Absolute rate constants obtained in this work are

$$H + C_2H_4 \rightarrow k_1 = 13.6 \pm 1.9 \times 10^{-13}\ (\text{cm}^3\ \text{molecule}^{-1} \cdot \text{sec}^{-1})$$
(extrapolated to infinite He pressure),

$$H + C_2H_5 \rightarrow k_4 = 6.0 \pm 2.0 \times 10^{-11}\ (\text{cm}^3\ \text{molecule}^{-1} \cdot \text{sec}^{-1})$$
(50 torr He).

The latter rate has been estimated from the variation of the rate of disappearance of H atoms as a function of initial H atom concentration at 50 torr total pressure.

**13289.** Ledbetter, H. M., **Poisson's ratio for polycrystals,** *J. Phys. Chem. Solids* **34,** No. 4, 721-723 (Apr. 1973).

Key words: Cauchy relations; elastic constants of solids; elasticity; Poisson ratio; polycrystals.

Accepted views concerning Poisson's ratio for central-force polycrystals are amended. For polycrystals the ratio can vary from 1/4, which is actually a lower limit. An upper limit of Poisson's ratio exists also. Both limits can be calculated from single-crystal elastic data. The limits correspond to Voigt's and Reuss's states of uniform local strain and of uniform local stress, respectively.

**13290.** Rowe, J. M., Hinks, D. G., Price, D. L., Susman, S., Rush, J. J., **Single crystal neutron diffraction study of sodium cyanide,** *J. Chem. Phys.* **58,** No. 5, 2039-2042 (Mar. 1, 1973).

Key words: Angular distribution; crystal structure; cyanide ion; Debye-Waller factor; neutron diffraction; orientational disorder; potassium cyanide; sodium cyanide.

The neutron diffraction pattern of a single crystal of cubic NaCN has been measured at 295 K. These data and earlier results for KCN at 180 and 295 K have been analyzed in terms of a model which expands the angular distribution of $CN^-$ orientations in symmetry-adapted spherical harmonics. From this analysis, the distributions of $CN^-$ in these crystals have been derived, and these indicate a monotonic trend in the series KCN (295 K) thru KCN (180 K) to NaCN (295 K) involving a shift in preferential orientation from the [111] toward the [100] directions in the crystal. Unusually large translational Debye-Waller factors have also been derived for NaCN and KCN from the fitting procedure, in agreement with earlier results and analysis on KCN. In addition, an average $C \equiv N$ bond distance of 1.18 Å is obtained.

**13291.** Wasik, S. P., Tsang, W., **Gas chromatographic determination of partition coefficients of some unsaturated hydrocarbons and their deuterated isomers in aqueous silver nitrate solutions,** *J. Phys. Chem.* **74,** No. 15, 2970-2976 (1970).

Key words: Aromatics; gas analysis; gas chromatography; isotope effect; isotopic separation; olefins; silver nitrate.

Experiments using aqueous solutions of silver nitrate as a gas chromatographic liquid phase have been carried out. Stability constants for the reaction, $(Ag^+)_{aq} + (\text{Hydrocarbon})_{aq} \rightleftarrows (Ag^+ \cdot \text{Hydrocarbon})_{aq}$, where $(\text{Hydrocarbon})_{aq}$ are various light olefins, aromatics, or some of their deuterated isomers have been determined. For the olefins these values are in quantitative agreement with those obtained from conventional static techniques. In the case of ethylene $\Delta H = -23$ kJ/mol and $\Delta S = -38$ J/mol deg. The isotope effect for the solubility of benzene-$d_6$ (compared to the lightest isomer) in water is 1.05. Aqueous silver nitrate columns should also have interesting analytical applications, particularly in the field of isotopic separations. They appear to be more efficient than the conventional ethylene glycol-silver nitrate columns.

**13292.** Herron, J. T., **An evaluation of rate data for the reactions of atomic oxygen ($O^3P$) with methane and ethane,** *Int. J. Chem. Kinet.* **1,** 527-539 (1969).

Key words: Atomic oxygen; ethane; evaluation; methane; rate data.

This review presents in tabular and graphical form rate data on the reactions of atomic oxygen ($O^3P$) with methane and ethane. The reliability of these data is discussed and suggested values of the rate constants are given over specified temperature intervals. Specific values are given for 298 and 1000 K.

**13293.** Dibeler, V. H., Walker, J. A., **Photoionization of acetylene near threshold,** *Int. J. Mass Spectrom. Ion Phys.* **11,** 49-56 (1973).

Key words: Franck-Condon factors; mass spectrometry; photoionization; Rydberg series; vacuum ultraviolet.

Photoion yield curves for $C_2H_2$ and $C_2D_2$ cooled to 118 K are remeasured at 0.2 Å intervals from ionization threshold to about 0.6 eV above threshold. Clearly defined autoionization features are observed superimposed on vibrational step structure. The latter observation suggests molecular predissociation occurring in competition with the autoionization process. A simple means of estimating Franck-Condon factors for the direct ionization in the presence of autoionization gives values in agreement with photoelectron spectroscopy data. Comparisons of observed and calculated Rydberg levels converging to vibrationally excited states of the molecular ion are discussed briefly.

**13294.** Wasik, S. P., Roscher, N. M., **Diffusion coefficients of paraffin-chain salts and the formation energetics of micelles,** *J. Phys. Chem.* **74,** No. 14, 2784-2787 (1970).

Key words: Decyltrimethyl ammonium bromide; diffusion coefficient; dodecyltrimethyl ammonium bromide; standard free energy; tetradecyltrimethyl ammonium bromide.

The diffusion coefficients of the colloidal electrolytes decyl, dodecyl, and tetradecyltrimethylammonium bromide have been measured as a function of concentration in aqueous solutions at 25°. These values compared favorably with values obtained from the theoretical expression derived by Hartley. A method is presented for determining the standard Gibbs free energy change of micelle formation from diffusion coefficient vs concentration plots.

**13295.** Meshkov, S., **Review of hadron spectroscopy,** (Proc. Int. Conf. on Duality and Symmetry in Hadron Physics, Tel Aviv, Israel, Apr. 5-7, 1971), Chapter 8 in *International Conference on Duality and Symmetry in Hadron Physics*, E. Gotsman, Ed., pp. 252-316 (The Weizmann Science Press of Israel, and The Jerusalem Academic Press, Jerusalem, Israel, 1971).

Key words: $A^2$; baryons, exotics; mesons; quarks; spectroscopy.

The present state of hadron spectroscopy is comprehensively reviewed. Classifications of the mesons and baryons according to the SU(6) × O(3) model are presented, as are discussions concerning the $Z^*$, the $A^2$ and exotic amplitudes.

**13296.** Yahalom, J., Ives, L. K., Kruger, J., **On the nature of films over corrosion pits in stainless steel,** *J. Electrochem. Soc.* **120,** No. 3, 384-386 (Mar. 1973).

Key words: Corrosion pits; electron microscopy; Fe-Cr alloys; passive films; stainless steel.

Thin films over corrosion pits in two commercial austenitic stainless steels, AISI 304 and 316, and three ferritic Fe-Cr alloys containing 5, 12 and 19 wt.% Cr were studied by means of transmission electron microscopy and scanning electron microscopy. It is shown that these films originally existed as the passive film on the metal surface. Electron diffraction and energy-dispersive x-ray analysis results are presented.

**13297.** Keller, R. A., **Effect of quenching of molecular triplet states in organic dye lasers,** *IEEE J. Quantum Electron.* **QE-6,** No. 7, 411-416 (July 1970).

Key words: Dye lasers; lasers; quenching agents; triplet states.

The effect of quenching of metastable triplet states upon the efficiency of organic dye lasers is considered in detail by solving the coupled differential equations describing the laser process. It is shown that specific quenching agents for excited triplet states can 1) cause a dramatic increase in the laser efficiency, 2) negate the previous requirements of very fast pumping sources, and 3) permit the use of dyes with relatively small fluorescence quantum yields. The addition of quenching agents that quench both singlet and triplet states (such as molecular oxygen) generally improves the efficiency although not as dramatically. Steady-state solutions were developed that lead to analytical expressions for the laser efficiency and the concentrations of the excited states as a function of time.

**13298.** Herron, J. T., Huie, R. E., **Rate constants for the reactions of $O_2$ $^1\Delta_g$ with 2,3-dimethyl-2-butene and 2,5-dimethylfuran,** *J. Chem. Phys.* **51,** No. 9, 4164-4165 (Nov. 1, 1969).

Key words: Chemical kinetics; mass spectrometry; olefins; rate constant; singlet oxygen; $O_2$ $^1\Delta_g$.

Rate constants for the gas phase reactions of $O_2$ $^1\Delta_g$ have been measured using a mass spectrometric technique at 300 K. Results are $k$(2,5-dimethylfuran) = $1.6 \pm 0.4 \times 10^{10}$ cm$^3$ mol$^{-1}$ s$^{-1}$ and $k$(2,3-dimethyl-2-butene) = $1.0 \pm 0.3 \times 10^9$ cm$^3$ mol$^{-1}$ s$^{-1}$ (estimated uncertainties). Additional rate constants relative to the rate constant for 2,3-dimethyl-2-butene have been measured as follows: 2,3 dimethyl-2-pentene, 0.7; 1-methylcyclopentene, 0.015; 1,2-dimethylcyclopentene, 0.4; 1,2-dimethylcyclohexene, 0.4; and 1,3-cyclohexadiene, 0.09.

**13299.** Rodriguez-Pasqués, R. H., Steinberg, H. L., Harding, J. E., Mullen, P. A., Hutchinson, J. M. R., Mann, W. B., **Low-level radioactivity measurements on aluminum, steel and copper,** *Int. J. Appl. Radiat. Isotop.* **23,** No. 10, 445-464 (1972).

Key words: Contamination of aluminum; copper and steel; low-level radioactivity measurements.

The radioactive contamination levels in samples of aluminum, steel and copper, supplied by a number of producers of these materials have been measured and activities have been assigned to possible natural radioelements. These activities were found to lie in the range of 0.02-0.6 pCi/g of parent radionuclide. The decay with time of some contaminants has been observed. A few measurements were also made on a number of other materials.

**13300.** Young, R. H., Brewer, D., Keller, R. A., **The determination of rate constants of reaction and lifetimes of singlet oxygen in solution by a flash photolysis technique,** *J. Amer. Chem. Soc.* **95,** No. 2, 375-379 (Jan. 24, 1973).

Key words: Lasers; photochemistry; photooxidation; $^1\Delta O_2$.

A flash photolysis technique, employing a dye-laser as the flash excitation source, was developed to determine, directly, the rate constant of decay ($k_d$) of singlet oxygen ($O_2{}^1\Delta_g$) and rate constant of reaction ($k_{rx}$) between singlet oxygen and 1,3-diphenylisobenzofuran, DPBF, in a variety of solvents. Some results are the following: methanol, $k_d = (9.0 \pm 0.6) \times 10^4$ sec$^{-1}$, $k_{rx} = (1.3 \pm 0.1 \times 10^9$ sec$^{-1}$ $M^{-1}$, $k_d/k_{rx} = 7.2 \times 10^{-5}$ $M$; *n*-butyl alcohol, $k_d = (5.2 \pm 0.8) \times 10^4$ sec$^{-1}$, $k_{rx} = (0.80 \pm 0.2) \times 10^9$ sec$^{-1}$ $M^{-1}$, $k_d/k_{rx} = 6.5 \times 10^{-6}$ $M$; *tert*-butyl alcohol, $k_d = (3.0 \pm 0.4) \times 10^4$ sec$^{-1}$, $k_{rx} = (0.57 \pm 0.08) \times 10^9$ sec$^{-1}$ $M^{-1}$, $k_d/k_{rx} = 5.3 \times 10^{-5}$ $M$. Values in benzene:methanol(4:1), bromobenzene:methanol (4:1), pyridine, dioxane, methanol:water(1:1), methanol:glycol (1:1), and glycol were also obtained. The resulting $\beta$ values ($k_d/k_{rx}$) are in good agreement with $\beta$ values determined in other ways. The technique was also shown useful for determination of absolute rate constants of reaction with or quenching of singlet oxygen by compounds such as 2,5-diphenylfuran and *N,N*-dimethylaniline.

**13301.** Kulin, G., **Discussion of the paper "Free overfall as a flow measuring device" by S. W. Bauer and W. H. Graf,** *Proc. Amer. Soc. Civil Eng., Irrigation Drainage Div.* **98, IR1,** Paper 8750, 159-165 (Mar. 1972).

Key words: Hydraulic measurements; open-channel flow; overfalls.

Effects of wall friction and mild slopes on rectangular free overfalls used for measuring open channel flow are discussed. Additional research needs are pointed out.

**13302.** Dillon, T. A., Stephenson, J. C., **Calculation of vibrational and rotational energy transfer between HF, DF, HCl, and $CO_2$,** *J. Chem. Phys.* **58,** No. 5, 2056-2064 (Mar. 1, 1973).

Key words: Energy transfer; HF, DF, $CO_2$; linewidth; unitary.

A theory of vibrational energy transfer which retains the exponential form of the scattering operator is applied to energy transfer between vibrationally excited HF, DF, HCl, and $CO_2$. The calculations contain several new features, including use of curved classical trajectories and vibrational wavefunctions obtained numerically from an RKR potential. Cross sections for multiquantum pure rotational changes caused by the dipole-quadrupole interaction are calculated. These multiquantum rotational transitions play an important role in vibrational energy exchange by allowing large vibrational energy defects to be absorbed by the rotational degrees of freedom. Agreement between theory and experiment is excellent. Cross sections calculated for simultaneous transfer of two vibrational quanta from HF or HCl to $CO_2$ are very small. However, for DF-$CO_2$ the calculated two-quantum-transfer cross section is only a factor of 2-6 smaller than that for single-quantum transfer.

**13303.** Bowen, R. L., Argentar, H., **A stabilizing comonomer: II. Stabilization and polymerization characteristics,** *J. Dent. Res.* **51,** No. 6, 1614-1618 (Nov.-Dec. 1972).

Key words: Antioxidants; biomaterials; comonomers; inhibitors; polymerization; stabilizers; toxicity.

BHM (3,5-di-*t*-butyl-4-hydroxybenzyl methacrylate) was evaluated with regard to its effectiveness as a stabilizer (polymerization inhibitor). This sterically-hindered phenol containing a methacrylate moiety was an effective stabilizer but it had lower efficiency than BHT (2,6-di-*t*-butyl-4-methylphenol). This is attributed to the greater steric hindrance at the *para* position and lower electron-donating nature of the *para*-substituent of the phenol, BHM. The homopolymer of BHM was prepared by polymerization of the methacrylate group, under anaerobic conditions, even though, under aerobic conditions it is an effective stabilizer.

**13304.** Barton, J. A., Jr., Eick, J. D., Dickson, G., **Comparison of Brinell and Vickers hardness tests on dental casting gold alloys,** *J. Dent. Res.* **52,** No. 1, 163-169 (Jan.-Feb. 1973).

Key words: Brinell hardness number; dental casting; gold alloy; indentation; Rockwell superficial hardness tester; Vickers hardness number; Vickers hardness tester.

A large group of dental casting gold alloys representing all four types listed in American Dental Association Specification No-5 were indented, using the Brinell and Vickers methods. The relationship between Vickers and Brinell hardness numbers was found to be linear with the addition of 19 to the Brinell number approximating the Vickers number fairly well. The coefficient of variation for the Brinell test was found to be about 1 percent less than that of the Vickers test. Surface preparation, grain size, and the position of the indentation with respect to grain structure did not affect the precision of the Vickers method. The effects of reading error and sample inhomogeneity on the precision of the Vickers values were also evaluated. The reading error was a large portion of the total error for types I, II, and III, but only about 35 percent of the total error for type IV alloys.

**13305.** Hadley, S. G., Keller, R. A., **Direct determination of the singlet → triplet intersystem crossing quantum yield in naphthalene, phenanthrene, and triphenylene,** *J. Phys. Chem.* **73,** No. 12, 4356-4359 (1969).

Key words: Aromatics; electronic spectroscopy; intersystem crossing; quantum yields; triplet states.

Radiationless singlet → triplet intersystem crossing quantum yields have been directly determined. The technique used depends upon using previously determined extinction coefficients to relate the optical density of the triplet ← triplet absorption and the absolute intensity of the light used to generate triplet state molecules to the intersystem crossing quantum yield. The quantum yields at 77 K in a rigid matrix and their estimated uncertainties were found to be naphthalene-$h_8$, $0.25 \pm 0.05$; naphthalene-$d_8$, $0.25 \pm 0.05$; phenanthrene-$h_{10}$, $0.35 \pm 0.07$; phenanthrene-$d_{10}$, $0.45 \pm 0.09$; triphenylene-$h_{12}$, $0.54 \pm 0.11$; and triphenylene-$d_{12}$, $0.88 \pm 0.18$. No significant deuterium isotope effects were noted on the intersystem crossing quantum yields.

**13306.** Davis, D. D., Braun, W., Bass, A. M., **Reactions of $Cl^2P_{3/2}$: Absolute rate constants for reaction with $H_2$, $CH_4$, $C_2H_6$, $CH_2Cl_2$, $C_2Cl_4$, and c-$C_6H_{12}$,** *Int. J. Chem. Kinet.* **11,** 101-114 (1970).

Key words: Absolute rate constants; atom-molecule reactions; chlorine atoms; resonance fluorescence.

The absolute rate constants have been measured for several gas-phase chlorine atom-molecule reactions at 25 °C by resonance fluorescence. These reactions and their corresponding rate constants in units of $cm^3\ mole^{-1}\ sec^{-1}$ are:

$$Cl^2P_{3/2} + H_2 \xrightarrow{k_1} HCl + H \qquad k_1 = 1.4 \pm 0.1 \times 10^{-14}$$

$$Cl^2P_{3/2} + CH_4 \xrightarrow{k_2} HCl + CH_3 \qquad k_2 = 1.5 \pm 0.1 + 10^{-13}$$

$$Cl^2P_{3/2} + CH_2Cl_2 \xrightarrow{k_5} HCl + CHCl_2 \qquad k_5 = 5.5 \pm 0.5 \times 10^{-13}$$

$$Cl^2P_{3/2} + C_2Cl_4 \xrightarrow{k_6} C_2Cl_5 \qquad k_6 = 5.3 \pm 0.5 \times 10^{-12}$$

$$Cl^2P_{3/2} + C_2H_6 \xrightarrow{k_7} HCl + C_2H_5 \qquad k_7 = 6.7 \pm 0.7 \times 10^{-11}$$

$$Cl^2P_{3/2} + \text{c-}C_6H_{12} \xrightarrow{k_8} HCl + \text{c-}C_6H_{11} \qquad k_8 = 2.0 \pm 0.2 \times 10^{-10}$$

The effects of varying the substrate pressure, total pressure, light intensity and chlorine-atom source on the value of the bimolecular rate constants have been investigated for all these reactions. Conditions under which no competing side reaction occurs were established and the reported rate constants were measured under these conditions. For reactions (2), (5), (6), (7), and (8), there is a discrepancy of a factor of two between the rate constants measured in this work and values in the literature; it is suggested that this is due to an error in the previously measured value of $k_{CH_4}/k_{H_2}$ upon which the relative measurements in the literature ultimately depend.

**13307.** Lester, W. A., Jr., Krauss, M., **Interaction potential between Li and HF,** *J. Chem. Phys.* **52,** No. 9, 4775-4781 (May 1, 1970).

Key words: Hartree-Fock approximation; induction energy; interaction potential; radial coefficients; scattering calculations.

The interaction potential between Li and HF has been determined in the Hartree-Fock approximation. An expression for the interaction potential has been determined in the case of fixed internuclear distance of HF in a form suitable for scattering calculations. The results are tabulated as radial coefficients for the intermolecular potential expressed as $V(r,\theta) = \Sigma_i v_i(r) P_i(\cos\theta)$. At long range, the Hartree-Fock calculation determines the induction energy of a spherical atom Li interacting with a dipolar molecule HF. For the approach of the Li atom toward the F atom, there is a minimum in the energy for a Li to HF center-of-mass distance of 4 a.u. Most of the hemisphere on the F side of the surface ultimately leads to reaction. On the other hand, the spherically symmetric component of the intermolecular potential, $(v_0(r)$, has a minimum at about 9 a.u. which is related to the potential well deduced from glory scatter data.

**13308.** Meijer, P. H. E., Colwell, J. H., Shah, B. P., **A note on the morphology of heat capacity curves,** *Amer. J. Phys.* **41,** No. 3, 332-339 (Mar. 1973).

Key words: Brillouin function; density of states; Einstein function; energy levels; harmonic oscillator; heat capacity; molecular field; molecular rotation; Schottky anomaly.

In this article we try to relate the general features of several types of heat capacity curves to the underlying energy level spectrum. We are interested in heat capacity "anomalies" (i.e., heat capacities which occur in addition to the usual lattice vibration and conduction electron contributions) and restrict ourselves to systems which can be described on an independent particle basis. We begin by considering Schottky anomalies and show the effects on the heat capacity of varying the spacings and degeneracies of the energy levels. The relation between the Schottky anomaly arising from the equally spaced non-

degenerate levels of the Brillouin function and the heat capacity of the Einstein function is discussed. The effects on the heat capacity of a marked local change in the density of states of an otherwise uniform energy-level spectrum is considered. The heat capacities of the free rotor and the molecular field model are used to exemplify particular points of the discussion.

**13309.** Linzer, M., Stokesberry, D. P., **A frequency-lock method for the measurement of $Q$ factors of reflection and transmission resonators,** *IEEE Trans. Instrum. Meas.* **IM-22,** No. 1, 61-77 (Mar. 1973).

Key words: Automatic $Q$ measurement; frequency-lock method; $Q$ measurement; reflection resonators; transmission resonators.

A new method for the measurement of $Q$ factors of reflection (single-ended) and transmission (double-ended) resonators has been developed. The basis of the technique is the locking of an oscillator to some point away from the center of the resonator response curve. This is accomplished by the introduction of a phase offset into a conventional oscillator-resonator stabilization circuit so as to make the stabilizer sensitive to both the real and imaginary portions of the voltage transfer coefficient of the resonator. From a determination of the phase and frequency shifts, the $Q$ factor may be evaluated.

The frequency-lock method shows promise of having significant advantages in speed, convenience, and accuracy over previous techniques. The basic features of this approach were successfully demonstrated in a measurement of the $Q$ factor of an $X$-band reflection cavity. A circuit for fully automatic $Q$ determinations is proposed. In this mode of operation, the device should be insensitive to changes in the eigen-frequency of the resonator and should be capable of measuring very small changes in $Q$.

**13310.** Levin, I. W., Abramowitz, S., **Isotopic splitting in matrix isolated $BF_3$,** *Chem. Phys. Lett.* **9,** No. 3, 247-248 (May 1, 1971).

Key words: $BF_3$; Coriolis; isotope effects; vibrational force field.

Small isotopic frequency shift information, if precisely determined, provides an effective constraint on intramolecular force fields. The most precise data for these frequency shift parameters $\Delta\nu$ are derived from high resolution, gas-phase infrared spectral analyses. In the present study, we compare for $BF_3$ the isotopic frequency shift $\Delta\nu_4$ from a recently published gas-phase study with the value for $\Delta\nu_4$ that we obtain from the spectrum of matrix isolated $BF_3$. The excellent agreement between the two methods suggests further applications of the matrix technique for obtaining precise frequency shift data.

**13311.** Page, C. H., **Ambiguities in the use of unit names,** *Science* **179,** 873-875 (Mar. 2, 1973).

Key words: Gyromagnetic ratio; measurement units; physical constants; SI units.

Experimental determinations of physical constants are usually reported in the literature in accepted units, such as SI. The actual measurements are *not* made in terms of the reported units, but in terms of the units maintained by a standards laboratory. This lack of precise identification of the results leads to ambiguities in comparing data from different countries, and in adjusting constants to make a most consistent set.

The semantics and algebra of the situation are presented, with a tentative resolution of the problem.

**13312.** Burdick, M. D., **Test for the adherence of porcelain enamel cover coats direct-to-steel,** *Porcelain Enamel Inst. Bull.* **T-29,** 1-10 (1972).

Key words: Adherence; direct-on porcelain enamels; impact.

An adherence test for direct-on-cover coat porcelain enamels has been developed. This test consists of deforming the porcelain enameled specimen with a 1/2 inch diameter ball with 80-inch pounds of energy into a 3/4 inch die. The adherence is then evaluated by determining the amount of enamel adhering after impact by measuring it with an adherence meter.

**13313.** Barnes, I. L., Garner, E. L., Gramlich, J. W., Moore, L. J., Murphy, T. J., Machlan, L. A., Shields, W. R., Tatsumoto, M., Knight, R. J., **Determination of lead, uranium, thorium, and thallium in silicate glass standard materials by isotope dilution mass spectrometry,** *Anal. Chem.* **45,** No. 6, 880-885 (May 1973).

Key words: Isotope dilution; lead; mass spectrometry; silicate glass standard materials; standard reference materials; thallium; thorium; uranium.

A set of four standard glasses has been prepared which have been doped with 61 different elements at the 500-, 50-, 1-, and 0.02-ppm level. The concentrations of lead, uranium, thorium, and thallium have been determined by isotope dilution mass spectrometry at a number of points in each of the glasses. The results obtained from independent determinations in two laboratories demonstrate the homogeneity of the samples and that precision of the order of 0.5 percent (95 percent L.E.) may be obtained by the method even at the 20-ppb level for these elements. The chemical and mass spectrometric procedures necessary are presented.

**13314.** Kessler, B. V., Meijer, P. H. E., **Calculation of behavior of paramagnetic systems with dipolar and exchange interactions,** *Phys. Rev. B* **7,** No. 6, 2839-2850 (Mar. 15, 1973).

Key words: Cerium ethyl sulfate; cerous magnesium nitrate; cobaltous fluosilicate; cupric potassium sulfate; dipole-dipole interaction; entropy; exchange interaction; ferric methyl ammonium alum; low temperature paramagnetism.

This paper deals with a precise calculation of the $b_2$ coefficients in the specific heat for a number of ultralow-temperature compounds. The result is given for the actual dipole-dipole interaction plus a varying amount of isotropic exchange $J$. Comparison with experimental data leads to a determination of $J$. Usually two values are possible as a result of the quadratic dependence of $b_2$ on $J$. Similar calculations are performed for the $T^{-3}$ term in the specific heat. In this case there are two types of contributions: one from the two-point summation and one from the three-point sum or ring diagram. The value of each is determined as a function of $J$. The values of $J$ as determined from the comparison of the experimental values of $b_2$ with the calculated values of $b_2$ are substituted in $b_3$ and the values thus predicted, on the basis of isotropic exchange, are given.

**13315.** Taragin, M. F., Eisenstein, J. C., Haller, W., **Mössbauer study of $Fe^{57}$ in an aluminophosphate glass,** *Phys. Chem. Glasses* **13,** No. 5, 149-152 (Oct. 1972).

Key words: Aluminophosphate glass; $Fe^{57}$; glass; iron; Mössbauer spectra; phosphate glass.

Mössbauer spectra of an aluminophosphate glass which contains 10 percent $Fe_3O_4$ were obtained from room temperature to 450 °C. $Fe^{2+}$ and $Fe^{3+}$ ions are present. The isomer shift and quadrupole splitting for these ions are each given as a function of

temperature, and it appears that both ions are in octahedral coordination. The ratio of the product of the Mössbauer fraction multiplied by the concentration ratio of $Fe^{3+}$ to $Fe^{2+}$ was determined. This ratio varies with temperature. A possible explanation is that the effective Debye temperatures are different for the two ionic species, being 385 K for $Fe^{3+}$ and 230 K for $Fe^{2+}$. The difference may possibly be attributed to differences in the sites occupied by $Fe^{3+}$ and $Fe^{2+}$ in the glass structure.

**13316.** Costrell, L., **CAMAC instrumentation system—introduction and general description,** *IEEE Trans. Nucl. Sci.* **NS-20,** No. 2, 3-8 (Apr. 1973).

Key words: CAMAC; dataway; instrumentation; modules; nuclear; standards.

The CAMAC instrumentation system developed by the ESONE Committee of European Laboratories has been endorsed by the U.S. AEC N1M Committee as a dataway system complementary to' the NIM (Nuclear Instrument Module) system. CAMAC is described in a general way in this introductory paper which is followed by papers that discuss the system in greater detail. This paper is an updated version of the introductory paper that appeared in the April 1971 IEEE Transactions on Nuclear Science.

**13317.** Zalewski, E. F., Keller, R. A., **Pressure dependence of intersystem crossing and triplet internal conversion in naphthalene vapor,** (Proc. Int. Conf. on Luminescence, University of Delaware, Newark, Del., Aug. 25-29, 1969), *J. Lumin.* **1,2,** 143-153 (1970).

Key words: Internal conversion; intersystem crossing; naphthalene vapor absorption spectrum; pressure effect on absorption spectrum; radiationless transitions.

The pressure dependence of intersystem crossing and internal conversion in the triplet manifold of naphthalene vapor was studied by monitoring the concentration of both the singlet ground state at the peak of and one minute after flash excitation, and the lowest triplet state at the peak of the flash. Helium was used as the foreign gas up to pressures of 460 torr. The pressure of naphthalene was 0.026 torr in all cases. In summary, the experimental results are: (1) Ground state depletion during the flash is independent of pressure. (2) The population of the lowest triplet state, experimentally zero initially, increases with increasing helium pressure and becomes constant above 100 torr. (3) Photodecomposition decreases with increasing pressure of helium and finally approaches zero at pressures greater than 100 torr. The conclusions which result from these observations are: (1) In the absence of collisions, photochemical decomposition of excited triplet molecules can compete effectively with internal conversion. (2) Intersystem crossing is not pressure dependent in naphthalene.

**13318.** Okabe, H., Mele, A., **Photodissociation of $NCN_3$ in the vacuum-ultraviolet production of CN $B\ ^2\Sigma$ and NCN $A\ ^3\Pi$,** *J. Chem. Phys.* **51,** No. 5, 2100-2106 (Sept. 1, 1969).

Key words: Absorption coefficient; bond dissociation energies; CN $B\ ^2\Sigma$; NCN $A\ ^3\Pi$; $NCN_3$; photodissociation; vacuum ultraviolet.

The photodissociation of $NCN_3$ in the vacuum ultraviolet has yielded CN $B\ ^2\Sigma$ and NCN $A\ ^3\Pi$. No NCN $^1\Pi$ was detected. The fluorescence intensity of the CN violet emission, $I_f/I_0$, was measured as a function of incident wavelength, $\lambda$. The $I_f/I_0$-vs-$\lambda$ curve shows structure, indicating that the process

$$NCH_3 \xrightarrow{h\nu} CN\ B\ ^2\Sigma + N_2,$$

is predissociative. The yield at 1216 Å is estimated to be approximately 2.5 percent. The threshold wavelength of incident photons to yield CN $B\ ^2\Sigma$ is $1685 \pm 20$ Å. The production of NCN $A\ ^3\Pi$ is attributed to the formation of $N_2\ A\ ^3\Sigma$

$$NCN_3 \xrightarrow{h\nu} NCN\ X\ ^3\Sigma + N_2\ A\ ^3\Sigma,$$

with the threshold wavelength of $1915 \pm 30$ Å followed by the sensitized reaction, $N_2\ A\ ^3\Sigma + NCN_3 \rightarrow NCN\ A\ ^3\Pi + 2N_2$. Bond dissociation energies obtained from threshold energies are $D(NC-N_3) = 4.2 \pm 0.1$ eV ($= 96 \pm 2$ kcal mole$^{-1}$) and $D(NCN-N_2) = 0.3 \pm 0.1$ eV ($= 7 \pm 2$ kcal mole$^{-1}$) where the error limit indicates an experimental uncertainty of the threshold energy measurements. Estimated heats of formation are $\Delta H_f°(NCN_3) = 4.7 \pm 0.2$ eV ($= 108 \pm 5$ kcal mole$^{-1}$) and $\Delta H_f°(NCN) = 5.0 \pm 0.2$ eV ($= 115 \pm 5$ kcal mole$^{-1}$) from which $D(N-CN)$ of $4.3 \pm 0.2$ eV ($= 99 \pm 5$ kcal mole$^{-1}$) is obtained. The absorption coefficient of $NCN_3$ in the region 1200 to 2000 Å has been measured. A comparison is made of bond energies of several azide compounds.

**13319.** Mele, A., Okabe, H., **Distribution of the excess energy in CN $B\ ^2\Sigma$ produced in photodissociation of cyanogen halides and hydrogen cyanide,** *J. Chem. Phys.* **51,** No. 11, 4798-4808 (Dec. 1, 1969).

Key words: BrCN; ClCN; CN $B\ ^2\Sigma$; energy partition; HCN; ICN; photodissociation; vacuum ultraviolet.

The vibrational and rotational excitations of CN $B\ ^2\Sigma$ produced in photodissociation of cyanogen halides and hydrogen cyanide in the vacuum ultraviolet have been measured as a function of incident wavelengths. More than 70 percent of the total population is in levels up to $v' = 3$. No population inversion was observed, indicating the photodissociation takes place without much change in the equilibrium C-N bond distance. The percent conversion of the excess energy to vibration is approximately 20 percent for cyanogen halides and about 12 percent for hydrogen cyanide, irrespective of the amount of excess energy, which is much less than that expected from the equipartition of energy in all vibrational degrees of freedom of the molecule. The rotational levels of CN $B\ ^2\Sigma$ are highly excited for all molecules. The extent of conversion of the excess energy to rotation is of the order of 10-20 percent for ICN and ClCN, and only several percent for BrCN and HCN. The remaining energy must be distributed as kinetic energy between CN $B\ ^2\Sigma$ and atoms. The vibrational and rotational distributions are discussed in terms of the equilibrium geometries of the ground and excited molecules and of the final products. The CN $A\ ^2\Pi$ state is also formed in photodissociation and apparently not directly but through the CN $B\ ^2\Sigma$. The intensity of the CN red emission is much less than that of the violet. Various other photodissociation processes are discussed. In general, the extent of conversion of the excess energy to vibration is much less than that expected from the equipartition theory for most triatomic molecules. No vibrational population inversion has been observed.

**13320.** Kaldor, A., Maki, A. G., **High resolution infrared spectrum and the molecular structure of sulfur trioxide,** *J. Mol. Struct.* **15,** 123-130 (1973).

Key words: Air pollution; bond distances; infrared spectroscopy; molecular structure; spectra; sulfur trioxide.

The $2\nu_3{}^2(E')$ band of sulfur trioxide has been measured with a resolution of 0.03 cm$^{-1}$. The analysis of this band yields a set of rotational constants which fit the data to within a standard deviation of 0.003 cm$^{-1}$ (which is the expected error limit). From the rotational constant $B_0 = 0.34857 \pm 0.00006$ cm$^{-1}$ the S-O bond distance is found to be $r_0 = 1.4198 \pm 0.0002$ Å. This value is in agreement with earlier infrared measurements, but represents a considerable improvement in accuracy.

**13321.** Loebenstein, W. V., **Adsorption of water on tooth components and related materials,** *J. Dent. Res.* **52,** No. 2, 271-280 (Mar.-Apr. 1973).

Key words: Adsorption; dental materials; hysteresis; sorption; surface area; teeth; water vapor.

By use of a novel, simply constructed, vapor-circulating apparatus, complete water adsorption isotherms, and surface areas derived therefrom, were obtained for tooth components and representative dental materials. Characteristic hysteresis loops were found for all materials studied.

**13322.** Hadley, S. G., Keller, R. A., **Direct determination of the extinction coefficients for triplet ← triplet transitions in naphthalene, phenanthrene, and triphenylene,** *J. Phys. Chem.* **73,** No. 12, 4351-4355 (Dec. 1969).

Key words: Aromatics; electronic spectroscopy; intersystem crossing; quantum yields; triplet states.

Extinction coefficients for triplet ← triplet absorption have been directly determined for several aromatic hydrocarbons. A high intensity photolysis lamp was used to populate the triplet state and the concentration of triplets was measured by monitoring the depletion of the ground state. The values of the extinction coefficients $\epsilon \times 10^{-4}$ (l. mol$^{-1}$ cm$^{-1}$) and their estimated uncertainties at the most prominent maximum λ(nm) are: naphthalene-$h_8$, $4.0 \pm 0.6$, 414.0; naphthalene-$d_8$, $4.0 \pm 0.6$, 414.0; phenanthrene-$h_{10}$, $3.8 \pm 0.6$, 492.5; phenanthrene-$d_{10}$, $3.1 \pm 0.5$, 492.5; triphenylene-$h_{12}$, $1.56 \pm 0.23$, 430.0; and triphenylene-$d_{12}$, $1.20 \pm 0.18$, 431.0. For anthracene, $\epsilon_T \geq 9 \times 10^4$ l. mol$^{-1}$ cm$^{-1}$ at 427.3 nm.

**13323.** Hampson, R. F., Jr., Okabe, H., **Collisional stimulation of the $O(^1S)-O(^1D)$ emission of oxygen atoms formed in vacuum-ultraviolet photolysis of nitrous oxide,** *J. Chem. Phys.* **52,** No. 4, 1930-1933 (Feb. 15, 1970).

Key words: Collisional stimulations; $N_2O$; $O^1S-O^1D$ emission; photodissociation; vacuum ultraviolet.

Oxygen atoms in the $^1S$ state have been produced by the vacuum-ultraviolet photolysis of $N_2O$ and observed by their emission at 5577 Å in the $^1S-{}^1D$ transition. The stimulation of this emission by collision with added gases has been studied. The emission has been found to be proportional to the pressure of the added gas. Xenon is the most efficient stimulator of the gases used, followed in order of decreasing efficiency by Kr, Ar, $N_2$, $H_2$, and He. Data gotten by photolysis of $NO_2$ and $CO_2$ have been used to estimate their quantum yields for formation of $O(^1S)$.

**13324.** Guttman, C. M., Flynn, J. H., **On the drawing of the base line for differential scanning calorimetric calculation of heats of transition,** *Anal. Chem.* **45,** No. 2, 408-410 (Feb. 1973).

Key words: Base line determination; differential scanning calorimetry (DSC); heats of transition; thermal analysis; thermoanalytical calorimetry.

The heat of transition has been computed from a Differential Scanning Calorimetry (DSC) trace by drawing a base line related only to the heat capacity of the transition's upper state.

**13325.** Stein, P. G., **Communications protocols: The search for SYN,** *Datamation* **19,** No. 4, 55-57 (Apr. 1973).

Key words: Asynchronous; communications; computer; data transmission; errors, protocol; synchronous.

This article gives a brief review of the field of serial data transmission with emphasis on protocols for synchronous communications. An example of such a protocol is given while describing a specific system implemented by the author. The importance of good system coordination and planning is stressed.

**13326.** Swartzendruber, L. J., Evans, B. J., **Giant hyperfine field at the antimony site in the Heusler-alloy $Pd_2MnSb$,** *Phys. Lett.* **38A,** No. 7, 511-512 (Mar. 27, 1972).

Key words: Alloys; hyperfine field; Mn; Mössbauer effect; Pd; Sb.

The magnetic hyperfine field at $^{121}Sb$ in $Pd_2MnSb$ has the anomalously large value (at 100 K) of $\pm 579 \pm 5$ kG. In the closely related compound PdMnSb we find $\pm 302 \pm 5$ kG, similar to other ferromagnetic intermetallics containing Mn and Sb.

**13327.** Braun, W., Bass, A. M., Davis, D. D., **Experimental test of a two-layer model characterizing emission-line profiles,** *J. Opt. Soc. Amer.* **60,** No. 2, 166-170 (Feb. 1970).

Key words: Atoms; hydrogen; resonance; spectra.

Deuterium Lyman-$\alpha$ line profiles, generated from a microwave-powered lamp containing flowing mixtures of deuterium in helium, were examined spectroscopically under high resolution. The primary purpose was to test a simple two-layer model describing the line shape emerging from a discharge zone containing both emitting and absorbing atoms. This simple model characterized the experimentally obtained line shapes under varying conditions of atom densities and line self-reversal. The kinetic (translational) temperature of the discharge could be calculated from the data. Resonance interaction between ground-state $D(^2S)$ atoms and excited $D(^2P)$ atoms is offered as an explanation for the experimentally observed line asymmetries. The presence of line self-reversal significantly amplifies the small spectral shifts between the absorption and emission lines. These shifts can be calculated from the model.

**13328.** Franklin, A. D., **Point defects in alkaline earth fluorides,** (Proc. 3d Int. Conf. on Sintering and Related Phenomena, University of Notre Dame, Notre Dame, Ind., June 5-7, 1972), Paper in *Materials Science Research,* G. C. Kuczynski, Ed., **6,** 19-27 (Plenum Publ. Corp., New York, N.Y., 1973).

Key words: Alkaline earth fluorides; $CaF_2$; clusters; defect models; $GdF_3$; mass transport; point defects.

Alkaline earth fluorides containing substitutional trivalent cations are known to contain fluorine interstitials as well, providing charge balance. It has been customary to assume that at low temperatures association between these impurity cations and interstitial anions controls the anion interstitial concentrations. However, an examination of EPR and optical data on quenched specimens of $CaF_2$: $GdF_3$ shows that this is probably not the case. Rather, interstitial clusters are formed at low temperatures. Sample calculations with a model of quenched crystals based upon this notion reproduces the main features of our previous data on variation of the relative concentrations of associated and unassociated $Gd^{3+}$ ions with $GdF_3$ content and annealing temperature.

**13329.** Hall, J. L., **Saturated absorption spectroscopy with applications to the 3.39 $\mu$m methane transition,** (Proc. 3d Int. Conf. on Atomic Physics, Boulder, Colo., Aug. 1972), Chapter in *Atomic Physics,* S. J. Smith and G. K. Walters, Eds., **3,** 615-646 (Plenum Publ. Corp., New York, N.Y., Feb. 1973).

Key words: Laser; methane; optical frequency standards; saturated absorption; spectroscopy.

In basic research we are grateful to be able to pursue research in profitable directions, e.g., those directions where the bounda-



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ries of experimental or theoretical possibilities seem most susceptible to growth. Of course we know of some areas that could be investigated and many numerical data recorded, but we are uneasy in not knowing how to make use of the data. As physicists we especially like to make progress synthesizing specialized concepts into more general forms. We savor the similarities—and differences—when ideas developed in one area prove useful in another set of circumstances. Just now it is optical resonance physics that seems to be ripe for explosive growth using new laser techniques and "classical" resonance ideas. This paper represents a direct effort to sketch, in the opinion of a certain class of partisans, "where the action is." We begin with a brief discussion of experiments in which a laser is useful but not necessary, and a consideration of the basic optical facts of life. The bulk of the paper explores the exciting land beyond the Doppler limit.

**13330.** Shields, J. Q., **Phase-angle characteristics of cross capacitors,** *IEEE Trans. Instrum. Meas.* **IM-21,** No. 4, 365-368 (Nov. 1972).

Key words: Capacitor; cross capacitor; dielectric films; loss angle; phase angle.

It has been found that under proper conditions thin dielectric films on the electrodes of certain types of cylindrical cross capacitors tend only to produce equal and opposite contributions to the phase angles of the two cross capacitances. To a lesser degree, this same type of cancellation effect has been found to be associated with toroidal cross capacitors.

**13331.** Caswell, R. S., Berger, M. J., **Theoretical aspects of radiation dosimetry,** (Proc. Conf. on Particle Accelerators in Radiation Therapy, Los Alamos, N. Mex., Oct. 2-5, 1972), Paper in *Conference on Particle Accelerators in Radiation Therapy,* **LA-5180-C,** 60-74 (Mar. 1973).

Key words: Absorbed dose distribution; electrons; heavy ions; interpretation of measurements; neutrons; pions; protons; radiation dosimetry; radiation quality; radiation transport theory.

A review of made of the role of theoretical dosimetry in interpretation of measurements, determination of the spatial distribution of absorbed dose, and in providing detailed physical information about radiation quality. The state of the art in calculating absorbed dose distributions in homogeneous tissue equivalent media is examined by comparisons with experiments for electron, proton, neutron, and pion beams. In cases where physical properties of the beam and medium are particularly well known, the accuracy can sometimes approach 5 percent. In a larger number of cases the accuracy is 10-15 percent or worse. Knowledge of absorbed dose distributions in realistic inhomogeneous media is rudimentary: new methods, schematizations, and further calculations are required. For improved absorbed dose calculations, further neutron and pion medium energy cross section information is needed.

Radiation transport calculations are providing detailed physical information needed for the various models of radiation action on biological materials. Such detailed information is usually not available from experiment. Improvement in these calculations will depend on improved knowledge of the interaction of electrons and heavy ions with matter. New pertinent atomic data are being generated, but the cross section data base for low energy calculations is far from complete.

**13332.** Cezairliyan, A., **Measurement of melting point, normal spectral emittance (at melting point), and electrical resistivity (about 2650 K) of niobium by a pulse heating method,** *High Temp.-High Pressures* **4,** 453-458 (1972).

Key words: Electrical resistivity; emittance; high-speed measurements; high temperature; melting point; niobium.

A subsecond duration pulse heating method is used to measure the melting point, normal spectral emittance (at the melting point), and electrical resistivity (above 2650 K) of niobium. The results yield a value of 2750 K for the melting point on the International Practical Temperature Scale of 1968. Normal spectral emittance at the melting point is 0.338, and remained constant during melting. At 2740 K electrical resistivity is $90.11 \times 10^{-8}$ ohm m. Estimated inaccuracy is 10 K in the melting point, 3 percent in normal spectral emittance and 0.5 percent in electrical resistivity.

**13333.** Goldberg, R. N., Prosen, E. J., **Evaluation of heats of transition in scanning calorimetry,** *Thermochimica Acta* **6,** No. 1, 1-11 (1973).

Key words: Heats of transition; scanning calorimetry; theory of calorimetry; thermal analysis.

A procedure for the evaluation of heats of transition in scanning calorimetry has been developed. A formula for evaluation of the energy of fusion of a compound at its melting point is derived that takes into account the baseline shift that is attributable to the heat capacity change on melting. Several other calorimeter parameters of importance are discussed. These include heat exchange between calorimeter vessel and jacket, the time constant of the instrument, the scanning rate, and the heater placement.

**13334.** Milligan, D. E., Jacox, M. E., McAuley, J. H., Smith, C. E., **Matrix isolation study of the vacuum-ultraviolet photolysis of $HCClF_2$ and of $HCCl_2F$. Infrared spectra of the parent molecules and of the $ClCF_2$ and $FCCl_2$ free radicals,** *J. Mol. Spectrosc.* **45,** No. 3, 377-403 (Mar. 1973).

Key words: $ClCF_2$; $DCClF_2$; $DCCl_2F$; $FCCl_2$; $HCClF_2$; $HCCl_2F$; infrared spectrum; matrix isolation; vacuum ultraviolet photolysis.

Studies of the vacuum-ultraviolet photolysis of $HCClF_2$ and of $HCCl_2F$ isolated in argon and nitrogen matrices at 14 K have led to the infrared spectroscopic identification of the free radicals $ClCF_2$ and $FCCl_2$, respectively. Support for this identification has been obtained from studies of the vacuum-ultraviolet photolysis of $DCClF_2$, of $DCCl_2F$, and of $H^{13}CCl_2F$, as well as from studies of halogen-atom abstraction from $CClF_3$ and from $CCl_3F$ by sodium atoms in an argon matrix environment. The C—Cl bonds of $FCCl_2$, like those of $CCl_3$ and of $HCCl_2$, appear to be exceptionally strong. Gas-phase infrared spectral data are also reported for $DCClF_2$ and for $DCCl_2F$, not previously studied. Vibrational assignments are proposed for these two molecules, and data supporting the reassignment of one of the C—F stretching fundamentals of $HCClF_2$ are presented.

**13335.** Hutchinson, J. M. R., Lantz, J. L., Mann, W. B., Mullen, P. A., Rodriguez-Pasqués, R. H., **An anti-coincidence shielded NaI(Tl) system at NBS,** *IEEE Trans. Nucl. Sci.* **NS-19,** No. 1, 117-118 (Feb. 1972).

Key words: Anti-coincidence shielding; low-level radioactivity measurements; scintillation counting; sodium-iodide crystals.

The anti-Compton anti-coincidence shielded 8 in NaI(Tl) crystal system recently installed at N.B.S. is described. This apparatus is composed of 2—8 in × 4 in well crystals which can be used in coincidence, and a 30 in diameter 20 in long cylindrical anti-Compton anti-coincidence scintillation plastic shield. The instrument is discussed as a particularly powerful tool for low level radioactivity calibration.

**13336.** Cotton, I. W., **Intelligent terminals,** *Datamation* **19,** No. 5, 149 (May 1973).

Key words: Computer terminals; intelligent terminals.

This article is a description of a forthcoming panel session on Intelligent Terminals which the author will chair at the 1973 National Computer Conference. The theme of the session is explained, and the paper authors and panelists are identified.

**13337.** Taylor, B. N., **Determining the Avogadro constant to high accuracy via improved measurements of the absolute ampere,** *Metrologia* **9,** No. 1, 21-23 (1973).

Key words: Absolute ampere; Avogadro number; fundamental constants.

It is shown how an improved measurement of the absolute ampere, that is, the ratio of a particular as-maintained unit of current to the absolute or *Système International d'Unités* (SI) unit of current, can now lead to an improved value of the Avogadro constant.

**13338.** Nahman, N. S., **Miniature superconductive coaxial transmission lines,** *Proc. IEEE* **61,** No. 1, 76-79 (Jan. 1973).

Key words: Cables; coaxial; cryogenic; miniature; pulse delay; superconducting; telecommunications; transmission lines.

This is a review paper concisely tracing the development of miniature superconductive coaxial transmission lines from the original invention as a vertical channel signal delay line for fractional nanosecond pulse oscillography to present-day work towards highly compact, broad-band, and low-loss telecommunication cables. The present state of development yields a 1.6-mm coaxial line operating at 4.2 K and having Pb conductors, polyethylene dielectric, $Z_0 = 50 \pm 0.3\ \Omega$ and a 1-GHz attenuation of the order of 1 dB/km. The attenuation up to 1 GHz is mainly due to dielectric losses.

**13339.** Adler, A., Kahan, W., Novick, R., Lucatorto, T., **Measurement of the lifetime and the electron-impact excitation cross section and polarization of the $2^3P$ term of singly ionized lithium,** *Phys. Rev. A* **7,** No. 3, 967-872 (Mar. 1972).

Key words: Electron-excitation cross section; lifetime; rf resonance spectroscopy; $2^3P$ term of $Li^+$.

The lifetime of the $2\ ^3P_j$ states in singly ionized lithium has been measured using an rf magnetic-resonance technique; the value is $\tau = 45 \pm 5$ nsec. Neutral lithium was ionized and excited by a unidirectional beam of electrons which produced an alignment in the excited state. The cross section for the electron-impact excitation $1s^2\ 2s\ ^2S \rightarrow 1s2p\ ^3P$ near the threshold was measured to be $10^{-22\pm1}$ cm$^2$. Implications for the feasibility of rf resonance spectroscopy on the fine and hyperfine structure of the $2^3P$ term will be discussed.

**13340.** Spicer, B. M., Danos, M., **Quartet structure and collective effects in the scandium isotopes,** *Z. Phys.* **246,** 97-103 (1971).

Key words: Core polarization; electromagnetic transitions; nuclear spectroscopy; nuclear structure; quadrupole moment; quartet structure.

The systematics of the excitation energies of the non-normal parity states of the scandium isotopes are interpreted in terms of the formation of a quartet of $1f_{7/2}$ nucleons. Calculation of the *B(E2)* value for a typical radiative transition between non-normal parity states in $^{43}$Sc, using this model, shows that the transition must involve more than the single quartet formed in the $1f_{7/2}$ shell; that is, that core polarization is an important factor in determining the *B(E2)* value.

**13341.** Spencer, L. V., Woolf, S., **"Forced-reflection" collimators and the n-n scattering experiment,** *Nucl. Instrum. Methods* **97,** 567-576 (1971).

Key words: Air ducts in shields; collimators; neutron instrumentation; neutron-neutron scattering; neutron penetration; re-entrant holes.

An approach to neutron collimator design is suggested in which wall-emergent neutrons are forced to reflect from the surface of each (tapered) segment beyond the point of emergence. Designs of this type, together with a suggested design for a proposed neutron-neutron scattering experiment, are compared in simple Monte Carlo and analytic studies.

**13342.** Dickens, B., Brown, W. E., **The crystal structure of $CaKAsO_4{\cdot}8H_2O$,** *Act. Crystallogr.* **B28,** Part 10, 3056-3065 (Oct. 1972).

Key words: Calcium arsenates; calcium phosphates; inorganic hydrate; ion hydration; single crystal x-ray diffraction.

$CaKAsO_4{\cdot}8H_2O$ crystallizes in the orthorhombic unit cell $a = 7.146(1)$, $b = 11.696(2)$, $c = 7.100\ (2)$ Å at 25 °C with cell contents of $2[CaKAsO_4{\cdot}8H_2O]$. The density calculated from the x-ray data is 2.027 g.cm$^{-3}$; that calculated from the refractive indices is 2.10 g.cm$^{-3}$. The structure has been refined to $R_w = 0.037$, $R = 0.043$ in space group *Cm2m*, using 1023 observed reflections measured on an automated diffractometer and corrected for absorption. Allowance was made for anomalous dispersion and secondary isotropic extinction. All ions in $CaKAsO_4{\cdot}8H_2O$ are completely hydrated. Ca coordinates to eight water oxygen atoms with Ca...O distances in the range 2.460(5) to 2.490(3) Å. K coordinates to eight water oxygen atoms with K...O distances ranging from 2.756(3) to 2.960(7) Å. The coordination polyhedron of Ca shares one face of four water molecules and two edges with neighboring coordination polyhedra of K. Each oxygen atom of the $AsO_4$ ion is the acceptor in hydrogen bonds from four water molecules and forms no bonds with the cations. The two crystallographically different As-O distances in the $AsO_4^{3-}$ ion are 1.682(4) and 1.684(4) Å when uncorrected for thermal motion, and 1.690 and 1.692 Å with the riding model correction. The structure of $CaKAsO_4{\cdot}8H_2O$ is related to that of $MgNH_4PO_4{\cdot}6H_2O$, struvite. This structural type may be common to several calcium phosphates and related compounds.

**13343.** Fabry, A., Jenkins, J. D., **Calculation of the ΣΣ facility with ENDF/B-versions II and III and comparison with experiment,** *Trans. Amer. Nucl. Soc.* **15,** No. 2, 1 (Nov. 1972).

Key words: Comparison; fast; integral-measurements; neutron; nuclear-data; spectra; standard; theory.

The intermediate-energy standard neutron spectrum facility ΣΣ is a permanent, clean, and reproducible standard neutron source characterized by a central radiation field typical of zero-power fast breeder test assemblies. It consists of a spherical shell of natural uranium of 24.5-cm o.d. x 5-cm thickness embedded at the center of a 50-cm-diam spherical cavity in a graphite thermal column: it contains a spherical shell of natural boron carbide 15 mm thick, which surrounds the central exposure zone of 11-cm diam. The ΣΣ central neutron spectrum and reaction rates have been computed with the evaluated nuclear data files ENDF/B Versions II and III. The one-dimensional discrete ordinates transport calculations were performed in the $S_{16}P_3$ approximation. Extensive measurements of infinitely dilute reaction rates in ΣΣ are compared to these calculations using detector cross sections from a current neutron dosimetry library. Sizable discrepancies are apparent. For the detector ratios with major response in the energy range above 50 keV, theory is

presently unable to reproduce the observed spectral indexes, especially the $^{238}U(n,f)/^{235}U(n,f)$ ratio: the deviation with respect to the trend indicated by the other threshold reactions is similar to the one previously suggested in cavity fission neutron spectrum integral measurements. The neutron spectrum between ~ 300 eV and 5 keV has been found very sensitive to the shape and intensity of the excitation function for the 45-keV $^{238}U$ level.

**13344.** Wiederhorn, S. M., Johnson, H., **Influence of sodium-hydrogen ion exchange on crack propagation in soda-lime silicate glass,** *J. Amer. Ceram. Soc. Discussions and Notes* **56,** No. 2, 108-109 (Feb. 1973).

Key words: Crack propagation; fracture; fracture mechanics; glass; strength; stress corrosion.

The effect of sodium-hydrogen ion exchange on crack propagation was studied. It was concluded that stresses arising from ion exchange play a minor role in determining the strength of glass when strength is controlled by crack propagation.

**13345.** Camarda, H. S., **Monte Carlo studies of $D_2O$ and $H_2O$ neutron moderators for time of flight experiments,** *Nucl. Instrum. Methods* **106,** 205-212 (1973).

Key words: Deuterium; moderator; Monte Carlo; neutrons; oxygen; protons, time delay; time smearing.

Calculations of neutron moderation in finite $D_2O$ and $H_2O$ media have been performed. Neutron spectrum shapes, time delays, and time smearings have been determined over a neutron energy range 1.8 keV $\leq E \leq$ 1 MeV.

**13346.** Bennett, J. A., Mindlin, H., **Metallurgical aspects of the failure of the Point Pleasant bridge,** *J. Test. Eval.* **1,** No. 2, 152-161 (Mar. 1973).

Key words: Bridge; failure; fracture toughness; Point Pleasant; stress corrosion cracking.

Examination of the fractured eyebar which caused the collapse of the bridge led to the conclusion that a stress-corrosion crack had penetrated to a depth of 1/8 inch during the 40 years that the bridge was in service. This flaw was sufficient to initiate fracture across the remainder of the 16 $in.^2$ area of the lower limb of the eye due to the high local stress and the low fracture toughness of the steel.

**13347.** Utech, H. P., **Injuries show what protection improved clothing should offer,** *Fire Eng.* **125,** No. 4, 47-49 (Apr. 1972).

Key words: Firefighter injuries; injury statistics; occupational injuries; protective clothing; protective equipment.

Firefighting continues to be one of this country's most hazardous occupations. Statistics on firefighter injuries are analyzed to identify the problem areas. This analysis indicates that improvement in the design of protective clothing and equipment can lead to the reduction of firefighter injuries. Improved respiratory protection, reduction in the weight and bulk of clothing and equipment, and better protection against impact, are the primary needs.

**13348.** Wiederhorn, S. M., **Prevention of failure in glass by proof-testing,** *J. Amer. Ceram. Soc.* **56,** No. 4, 227-228 (Apr. 1973).

Key words: Crack propagation; failure prevention; fracture; glass; proof testing.

A method of predicting the minimum lifetime of glass under static load is presented. The method involves proof testing and a knowledge of the growth behavior of cracks in glass.

**13349.** Wiederhorn, S. M., Johnson, H., **Effect of electrolyte pH on crack propagation in glass,** *J. Amer. Ceram. Soc.* **56,** No. 4, 192-197 (Apr. 1973).

Key words: Crack propagation; fracture; fracture mechanics; glass; strength; stress corrosion.

Crack velocities in glass in various acids, bases, and neutral solutions were studied using the double-cantilever-beam technique. Results are explained in terms of crack-tip pH, which is controlled by the electrolyte at low crack velocities and by the glass composition at high velocities. The crack-velocity data are consistent with the known dependence of strength on pH for soda-lime silicate glass. Results also suggest that the slope of the universal fatigue curve should depend on surface pH.

**13350.** Franklin, A. D., **Density of $CaF_2$ containing low concentrations of $GdF_3$,** *J. Nonmetals* **1,** 27-34 (1972).

Key words: Calcium fluoride; cation vacancies; density; gadolinium impurity; interstitial anions; lattice parameter; point defects.

The density relative to that of pure crystals has been measured for $CaF_2$ crystals containing mole fractions from 0 to $4.6 \times 10^{-3}$ of $GdF_3$, and the lattice parameters of these and also of pure crystals were measured. The doped crystals had been annealed at temperatures from 500 to 1100 °C in an atmosphere of He plus HF. No influence of annealing was seen on either the density or the lattice parameter. The precision of both measurements is, however, not quite good enough to rule out definitely an earlier suggestion that cation vacancies play an important role in the annealing behavior of this system. However, the density changes accompanying the incorporation of these amounts of $GdF_3$ in $CaF_2$ are too large to be accounted for by the usual model in which $Gd^{3+}$ occupies a cation site and is accompanied by an extra $F^-$ ion in an interstitial site. The changes do agree with a model in which one HF molecule accompanies each $GdF_3$ unit added, but attempts to detect the HF in nmr and infra-red absorption experiments were unsuccessful.

**13351.** Mabie, C. P., Jr., **Petrographic study of the refractory performance of high-fusing dental alloy investments: I. High-fired, phosphate-bonded investments,** *J. Dent. Res.* **52,** No. 1, 96-110 (Jan.-Feb. 1973).

Key words: Alloy; casting; dental; investment; petrography.

Detailed x-ray, optical microscopic, optical emission, and electron probe analyses of a phosphate-bonded investment before and after firing and after casting were made. Complex sintering reactions that involve incipient liquefaction generate bonds in the fired investment. The refractory behavior of this investment, which is reflected by the extent of liquefaction induced by casting, may influence casting roughness, fit, and porosity.

**13352.** Yule, H. P., **Conversational text editor for a laboratory minicomputer,** *Anal. Chem.* **44,** No. 2, 430 (Feb. 1972).

Key words: Assembly; conversational; editor; language; minicomputer; text.

A conversational text editing program for the Varian 620i minicomputer is described. Virtually identical in operation with a commercially available, time-sharing, conversational text editor, this program permits rapid and easy modification of text, including insertion, deletion, and editing of lines of text.

**13353.** Lang, R., Bender, P. L., **Analytic approximation for the saturation behavior of OH emission regions,** *Astrophys. J.* **180,** No. 2, 647-660 (Mar. 1, 1973).

Key words: OH microwave transition; radio astronomy; saturation; stimulated emission.

One of the simplest models for a cosmic maser consists of a homogeneous spherical region in which inverted population is created at a uniform rate. We have investigated the radiation transfer problem including saturation for this case under the following assumptions: (1) two levels only, without magnetic sublevels; (2) a square line shape; (3) excitation by spontaneous emission at a uniform rate through the region; and (4) no scattering in the medium or reflection at the boundary. An approximate analytic solution has been found which closely satisfies the radiation transfer equation under conditions of substantial saturation. This analytic solution has been checked against numerical solutions which are intended to approximate the flux and apparent size of the $-43.7$ km s$^{-1}$ feature in W3. Both the analytic solution and the numerical models show that the actual size of an emitting region can be considerably larger than for a region of uniform population difference which has the same apparent size.

**13354.** Deslattes, R. D., ***L*-series emission spectrum of germanium,** *Phys. Rev.* **172,** No. 3, 625-627 (Aug. 15, 1968).

Key words: Emission spectrum; germanium; profile measurement; valence emission bands.

Measurements are reported on the *L*-series emission spectrum of germanium which lead to line identifications at variance with other recent work. Some features of the *K*-emission spectrum were also recorded to confirm previous work there and aid in the location of the valence emission bands in the *L* series. It is shown that these are of extremely low intensity, so low in fact as to preclude for the present a detailed profile measurement.

**13355.** Fong, J. T., Simmons, J. A., **A decomposition theorem on the scalar potential of a compressible BKZ fluid,** *J. Appl. Math. Phys.* **23,** No. 5, 780-794 (1972).

Key words: Anisotropy; BKZ fluid; composite material; continuum mechanics; hyperelasticity; isothermal; nonlinear; variational principle; viscoelasticity.

Based on the existence of a caloric equation of state in the thermodynamic theory of a nonlinear viscoelastic fluid (Bernstein, Kearsley and Zapas, 1964), and the additional assumption that the local entropy production along any instantaneous deformation path is finite, we first show that such a fluid behaves as a perfectly elastic material whenever the deformation gradient suffers from a jump-type discontinuity. The nature of the apparently perfectly elastic material serving to interpret results in the instantaneous deformation depends on the previous history only through two parameters, namely, the density and the temperature of the fluid immediately prior to the jump. This result is then applied, in conjunction with the usual conditions of isotropy and objectivity as well as an application of Schur's Lemma on irreducible sets of matrices, to obtain a decomposition of the scalar potential of the compressible Bernstein-Kearsley-Zapas Fluid (abbrev. BKZ Fluid).

**13356.** Zimmerman, J. E., **Possible parametric capacitance in Josephson junctions,** *Phys. Lett.* **42A,** No. 5, 375-376 (Jan. 1, 1973).

Key words: Josephson effect; parametric capacitance.

The capacitance of a Josephson junction is much larger (at least in the low frequency limit) than the classical value $\epsilon A/l$, and is a function of the phase difference $\theta_0$.

**13357.** Reader, J., **Comment on "Configuration interaction in the x-ray photoelectron spectra of alkali halides,"** *Phys. Rev. A* **7,** No. 3, 1431-1433 (Apr. 1973).

Key words: Photoelectron spectra; potassium; rubidium; sodium; x-rays.

Recently obtained data on doubly ionized Rb in the free state indicate that the satellite of the Rb(4*s*) resonance in the photoelectron spectra of RbF and RbCl is primarily due to a $4s^24p^44d\ ^2S$ final state rather than a $4s^24p^45s\ ^2S$ one. For the potassium salts, the satellite of the K(3*s*) resonance is most likely due to a $3s^23p^43d\ ^2S$ final state. The absence of a satellite for the Na(2*s*) resonance for the sodium salt is due to the nonexistence of 2*d* electrons.

**13358.** Linsky, J. L., Ayres, T., **Stellar model chromospheres. 1. On the temperature minima of F, G, and K stars,** *Astrophys. J.* **180,** No. 2, Part 1, 473-481 (Mar. 1, 1973).

Key words: Spectral line formation; stellar chromospheres.

Brightness temperatures are deduced for the $H_{1V}$ and $K_{1V}$ features of the Ca II resonance lines in Procyon (F5 IV-V), Arcturus (K2 IIIp), and the Sun (G2 V). The brightness temperatures of Procyon and the Sun are in the same ratio as their effective temperatures, suggesting a simple scaling law for the temperature minima of F and early G stars. Arcturus departs from this law in a way that can be explained by CO line blanketing.

**13359.** Kamper, R. A., Simmonds, M. B., Adair, R. T., Hoer, C. A., **A new technique for RF measurements using superconductors,** *Proc. IEEE* **61,** No. 1, 121-122 (Jan. 1973).

Key words: Josephson effect; quantum interference; rf attenuation; rf measurements; superconductivity.

The quantization of magnetic flux in a superconducting circuit can serve for the measurement of electrical quantities in the same way that we use the wavelength of light to measure length. We report a demonstration of this function in the measurement of attenuation ratio at a frequency of 30 MHz.

**13360.** Linsky, J. L., **The moon as a proposed radiometric standard for microwave and infrared observations of extended sources,** *Astrophys. J. Suppl. Ser.* **25,** No. 216, 163-204 (Feb. 1, 1973).

Key words: Absolute radiometric calibration—astronomical; absolute radiometric calibration—infrared; absolute radiometric calibration—microwave; lunar surface; lunar thermal emission; moon.

Measured values of the average midnight and morning terminator infrared brightness temperatures of the central portion of the lunar disk can quite accurately determine the mean surface temperature despite likely horizontal and vertical inhomogeneities of the thermal properties of the lunar soil. These data together with laboratory measurements on lunar soil and in situ temperature measurements in and on the lunar surface lead to a mean surface temperature of 220.5 K $\pm$ 2.5 percent and a mean temperature 35 K hotter at a depth of 1 m. The monthly average brightness temperature is then estimated as a function of wavelength between 10 $\mu$m and 100 cm taking into account likely temperature dependencies of the thermal conductivity and loss tangent, and the variation of emissivity with wavelength. The accuracy with which the Moon can be used as an absolute radiometric standard for extended sources is estimated based on the likely range of lunar thermal and electromagnetic properties.

**13361.** Danos, M., Gillet, V., **Quartet effects in the nuclear masses and excitations,** *Z. Phys.* **249,** 294-311 (1972).

Key words: Nuclear binding energies; nuclear quartets; nuclear reactions; nuclear structure; quartet model; supermultiplet theory.

The assumptions of the quartet model are given and it is shown that they are consistent with the fine structure of the nuclear mass curves throughout the table. It is also shown by an analysis of the nuclear masses that the quarteting effect accounts for 2/3 of the neutron binding energies. The consequences of the quartet picture for the existence of low-lying many-particle many-hole states in medium and heavy nuclei are discussed.

**13362.** Kushner, L. M., **Progress report on activities of the National Bureau of Standards under the 1967 Amendments to the Flammable Fabrics Act,** *Proc. 3d Annual Meeting of the Information Council on Fabric Flammability, New York, N.Y., Dec. 4, 1969,* pp. 156-163 (Information Council on Fabric Flammability, New York, N.Y., 1969).

Key words: Flammable fabrics; flammability standards; National Advisory Commission for the Flammable Fabrics Act; 1967 Amendments to the Flammable Fabrics Act.

Presents a summary of activities at the National Bureau of Standards since enactment of the 1967 Amendments to the Flammable Fabrics Act.

**13363.** LaVilla, R. E., **Carbon and fluorine x-ray emission and fluorine *K* absorption spectra of the fluoromethane molecules, $CH_{4-n}F_n$ ($0 \leq n \leq 4$). II,** *J. Chem. Phys.* **58,** No. 9, 3841-3848 (May 1, 1973).

Key words: Calculated relative x-ray emission; carbon $K\alpha$ emission; fluorine *K* absorption; fluorine $K\alpha$ emission; fluoromethane molecules; methane; molecular orbital level sequence.

The carbon and fluorine $K\alpha$ emission and the fluorine *K* absorption spectra of the molecular gases $CH_{4-n}F_n (0 \leq n \leq 4)$ are reported. All the spectra were obtained on a single flat crystal spectrometer with photon counting. The emission spectra, which were excited by direct electron bombardment, are in fair agreement with an interpretation based on electric dipole transitions between single vacancy states and molecular orbital theory for the molecules. The applicability of x-ray emission spectra to the determination of orbital order of a molecule is illustrated. The proximity of the resonance structure in the fluorine *K* absorption spectra for $CH_{4-n}F_n (1 \leq n \leq 4)$ to their respective fluorine *K* shell thresholds suggests that the resonance structure is due to transitions to excited valance states $1a \rightarrow V^*$ rather than Rydberg states.

**13364.** Ku, H. H., **Analysis of information-an alternative approach to the detection of a correlation between the sexes of adjacent sibs in human families,** *Biometrics* **27,** 175-182 (Mar. 1971).

Key words: Analysis of information; categorial data; chi-square; contingency table; independence; Markov chain.

Through the use of an example given by Greenberg and White [1965], the analysis of a multiway contingency table by the information approach is illustrated. Analyses of information tables are given for independence, homogeneity, conditional independence and conditional homogeneity, and Markovity.

**13365.** Fabry, A., Jenkins, J. D., **Wall return neutron fluxes for high- and intermediate-energy cavity neutron sources,** *Trans. Amer. Nucl. Soc.* **15,** No. 2, 975-976 (Nov. 1972).

Key words: Carbon; cavity; fast neutron; spectra; theory.

Spherical cavities in graphite thermal columns of nuclear reactors provide an ideal environment for the production of comparatively intense, energy distributed neutron fields, i.e., either intended pure fission neutron spectrum sources or intermediate-energy standard neutron spectra. Cavities of 50 cm diameter are used in various laboratories; a 30 cm diameter cavity is operated at NBS and a 1 meter diameter cavity has recently been implemented at CEN-SCK.

Numerical computations of graphite wall-return neutron spectra have been performed by means of the discrete ordinates multigroup method in one-dimensional spherical geometry. The evaluated nuclear data files KEDAK, ENDF/B Version 3 have been used and the convergence of the $S_n$ multigroup multitable treatment has been established systematically.

Within the cavity, a good approximation of the wall return is

$$\phi_W(r,\mu,E;r_s) = \phi_W(E).$$

This relationship is correct to better than 2% for r, $r_s \leq R/2$ where R is the cavity radius and $r_s$ the radius of a thin, fission spectrum source shell. This fundamental property has led to the development of an experimental method for determining wall-return backgrounds.

**13366.** Roberts, J. R., Andersen, T., Sørensen, G., **Determination of atomic lifetimes and absolute oscillator strengths for neutral and ionized titanium,** *Astrophys. J.* **181,** 567-586 (Apr. 15, 1973).

Key words: Absolute transition probabilities; arc; beam foil; experimental; lifetimes; titanium.

Measurements of atomic lifetimes by the beam-foil technique and branching ratios by use of a gas-flow stabilized arc have led to an experimental determination of absolute oscillator strengths of Ti II. Some lifetimes of Ti I, Ti III, and Ti IV are also presented.

**13367.** Roberts, J. R., Andersen, T., Sørensen, G., **Determination of atomic lifetimes and absolute oscillator strengths for neutral and ionized vanadium,** *Astrophys. J.* **181,** 587-604 (Apr. 15, 1973).

Key words: Absolute transition probabilities; arc; beam foil; experimental; lifetimes; vanadium.

Measurements of atomic lifetimes by the beam-foil technique and branching ratios by use of a gas-flow stabilized arc have led to an experimental determination of absolute and relative oscillator strengths of V I and V II. Some lifetimes of V III are also presented.

**13368.** Liebman, J. F., Vanderspurt, T. H., **Polarization of X-F bonds,** *J. Fluorine Chem.* **2,** 413-424 (1972/73).

Key words: Fluorine; polarization of bonds; proton assisted reactions; X-F bonds.

We discuss in this paper several reactions of compounds containing X-F (X=C, N, O, F, S and Xe) bonds. An attempt to unify these reactions conceptually is made by suggesting the importance of X-F bond polarization by protic media. Related Lewis-acid-induced polarization reactions can usually be envisioned. Some new reactions and mechanisms are suggested as a consequence of our analysis.

**13369.** Grundl, J. A., **Brief review of integral measurements with fission spectrum neutrons,** (Proc. of the Consultants' Meeting, Vienna, Austria, Aug. 1971), Paper in *Prompt Fission Neutron Spectra,* pp. 29-32 (International Atomic Energy Agency, Vienna, Austria, 1972).

Key words: Fission spectra; integral measurements; cross sections.

The paper is an edited transcript of the introduction to the discussion of integral measurements of fission cross-sections averaged over fission spectra given by the author at the meeting.

**13370.** Artru, M-C., Kaufman, V., **Re-evaluation of parameters for even configurations of triply ionized magnesium,** *J. Opt. Soc. Amer.* **63,** No. 4, 449-450 (Apr. 1973).

Key words: Magnesium; source; spectra; ultraviolet; wavelengths.

In a previous publication, HF values for $2p^4\ 3s \leftrightarrow 2p^4\ 3d$ interaction parameters were misinterpreted. Correct HF values for these parameters have been used in a new calculation of these configurations.

**13371.** Jones, M. C., **Use of superconductors in thermal insulations,** *Cryogenics* **13,** No. 2, 83-84 (Feb. 1973).

Key words: Niobium; superconductors; thermal radiation shields; total emissivity.

A suggestion is made for using superconductors as thermal radiation shields at or below liquid helium temperatures. Calculations are described which predict total emissivities for niobium of $10^{-4} - 10^{-5}$ at 4 K and $10^{-8} - 10^{-7}$ for temperatures of 1 – 2 K.

**13372.** Robertson, B., **Introduction to field operators in quantum mechanics,** *Amer. J. Phys.* **41,** 678-690 (May 1973).

Key words: Field operators and statistics; Fock space; occupation number; permutation symmetry of wave functions; quantum mechanics; second quantization.

The equivalence of the field operator formulation of quantum mechanics and ordinary wave mechanics is proved in an efficient and elementary way. The discussion proceeds algebraically from the (anti-) commutation relations, which the field operators are defined to satisfy. Although the paper is introductory and presumes only a knowledge of elementary wave mechanics, it is intended to cover all of the essential elements of the subject in a rigorous way.

**13373.** Cezairliyan, A., **High-speed (subsecond) simultaneous measurement of specific heat, electrical resistivity, and hemispherical total emittance of Ta-10 (wt.%)W alloy in the range 1500 to 3200 K,** *High Temp.-High Pressures* **4,** 541-550 (1972).

Key words: Electrical resistivity; emittance; high-speed measurement; high temperature; specific heat; Ta-W alloy.

Simultaneous measurements of specific heat, electrical resistivity, and hemispherical total emittance of Ta-100(wt.%)W alloy in the temperature range 1500 to 3200 K by a subsecond-duration pulse-heating technique are described. Estimated inaccuracies of measured properties are: 3% for specific heat and hemispherical total emittance, and 0.5% for electrical resistivity. Properties of the alloy are compared with the properties of the constituent elements. The values of measured specific heat are approximately 2% higher than the values computed according to Kopp's additivity law. However, this difference is within the combined estimated errors. The electrical resistivity results indicate a significant departure from Matthiessen's law. Like tantalum, the alloy showed a negative departure from linearity in the temperature dependence of electrical resistivity.

**13374.** Fuller, G. H., **Problems of compiling and evaluating or what is the nuclear moment?** (Proc. Int. Conf. on Nuclear Moments and Nuclear Structure, Osaka, Japan, Sept. 4-8, 1972), *J. Phys. Soc. Jap.* **34,** Supplement, 153-154 (1973).

Key words: Compilation problems; nuclear magnetic moments.

A "best-value" list of nuclear magnetic moments to accuracies of 0.01% or better is unrealistic at this time. There are many fundamental problems which are associated with the measurement of a nuclear moment in the laboratory where the nucleus is part of an atom or molecule in a gas, liquid or solid mixture. These problems are compounded by poorly written papers with much important information needed for the re-evaluation of data missing.

**13375.** Waxman, M., Hilsenrath, J., Chen, W. T., **Compressibility factor and the second virial coefficient of boron trifluoride from 0 to 225 °C and for pressures up to 250 bar,** *J. Chem. Phys.* **58,** No. 9, 3692-3701 (May 1, 1973).

Key words: Boron trifluoride; density, second virial coefficients; gas, compressibility.

The isothermal compressibility factor of boron trifluoride has been determined from a regression analysis of Burnett PVT measurements to an accuracy of 0.1% at 13 temperatures from 0 to 225 °C and for pressures up to 250 bar. The analysis has also yielded the second virial coefficient for each temperature. A correction for the presence of sorption has been included in the data reduction.

**13376.** Coxon, B., Schaffer, R., **Analysis of a cortisol clinical standard by Fourier transform, proton magnetic resonance spectroscopy,** *Anal. Lett.* **6,** No. 4, 291-300 (1973).

Key words: Chemical shifts; clinical Standard Reference Materials; cortisol; Fourier transform, proton magnetic resonance spectroscopy.

Cortisol intended for use as a clinical Standard Reference Material has been subjected to liquid chromatography and the resulting fractions analyzed by thin layer chromatography and Fourier transform, proton magnetic resonance spectroscopy at 90 MHz. Four steroid impurities and one artifact have been characterized by means of computer measured chemical shifts.

**13377.** Grundl, J. A., Spiegel, V., Jr., Eisenhauer, C., **Measurement of $^{235}$U and $^{238}$U fission cross sections for $^{252}$Cf spontaneous fission neutrons,** *Trans. Amer. Nucl. Soc.* **15,** No. 2, 945-946 (1972).

Key words: Absolute fission cross section; californium neutron source.

Absolute $^{235}$U and $^{238}$U fission cross sections have been measured with a small, low-mass $^{252}$Cf spontaneous fission source and a lightweight, double fission ionization chamber.

**13378.** Nahman, N. S., **A note on the transition (rise) time versus line length in coaxial cables,** *IEEE Trans. Circuit Theory* **CT-20,** No. 2, 165-167 (Mar. 1973).

Key words: Cables; coaxial; pulse response; transient analysis; transmission lines.

A tutorial discussion is given on the relation between the shape of the transition (rise) time versus length curve and that of the frequency domain attenuation. An analysis is developed in terms of hypothetical cable attenuation responses having a frequency $f$ dependence of $f^m$, where $m$ is a constant $0 < m < 1$. It is shown that if the $f^m$ law prevails, then the transition time depends on the length $l$ as $l^{1/m}$. Practical applications are made to RG 58C/U, RG 59B/U, and RG 63B/U.

**13379.** Dodge, M. J., Malitson, I. H., Mahan, A. I., **A special method for precise refractive index measurement for uniaxial optical media,** *Appl. Opt.* **8,** No. 8, 1703-1705 (Aug. 1969).

Key words: Refractive index; refractometry; ruby.

A method was developed for measuring the refractive index of optical glasses and uniaxial crystalline solids when established refractometric methods are not feasible. A synthetic ruby cuboid was contacted to a prism of known refractive index and a spec-

trometer was used to measure the angles describing the optical path through the ruby-glass combination. Ray tracing equations were derived to compute the refractive index accurate within $3 \times 10^{-5}$. Index values for both polarizations of ruby are given at selected wavelengths from 0.4358 $\mu$m to 0.7065 $\mu$m.

**13380.** Kirby, R. K., **Thermal expansion of tungsten from 293 to 1800 K,** *High Temp.-High Pressures* **4,** 459-462 (1972).

Key words: Standard Reference Materials; thermal expansion; tungsten.

Measurements on the thermal expansion of three samples of tungsten were made with a twin-microscope method in the range of 1000 to 1800 K. Measurements were also made on one of these samples with a Fizeau interferometer in the range below 1100 K. The results obtained indicated that the values for the expansion of the three samples, two prepared by sintering and one by arc melting, are in reasonable agreement with one another and with some of the data in the literature.

**13381.** Weisman, I. D., **$^{109}$Ag Knight shift in an $Ag_{0.96}Al_{0.04}$ alloy,** *J. Chem. Eng. Data* **18,** No. 2, 146 (Apr. 1973).

Key words: Absorption derivative; alloys; asymmetry; host; lineshape; $^{109}$Ag Knight shift.

The $^{109}$Ag Knight shift in a $Ag_{0.96}Al_{0.04}$ alloy has been measured with respect to $^{109}$Ag metal at room temperature. The change in shift is $-0.015$ ($\pm 3\%$).

**13382.** Ruff, A. W., Ives, L. K., **On the temperature dependence of stacking fault energy in cubic and hexagonal silver-tin alloys,** *Phys. Status Solidi A,* No. 16, 133-149 (1973).

Key words: Annealing; cubic alloy; dislocation; electron microscopy; hexagonal alloy; silver-tin alloy; stacking fault energy.

Measurements on extended dislocation nodes and double ribbons have been made between room temperature and 500 °C using transmission electron microscopy. Two low stacking fault energy (SFE) alloys with compositions near the mixed phase region were principally studied; 9 at% Sn (f.c.c.) and 11.9 at% Sn (hexagonal). The SFE in the cubic alloy increased *reversibly* with increasing temperature from 270 to 500 °C; a corresponding decrease in SFE was observed in the hexagonal alloy. Both alloys showed a substantial *irreversible* change in faulted defect size upon annealing, comparing results in as-deformed specimens with those from material annealed above 270 °C. The irreversible behavior is attributed to solute pinning of the partial dislocations. The dependence of SFE on composition throughout the f.c.c. and hexagonal phase regions is considered in light of these results.

**13383.** Baker, M. A., **Weatherability of porcelain enamels,** (Proc. Aluminum Finishing Seminar, Chicago, Ill., Mar. 19-21, 1973), Paper C12 in Applied Session: Technical Papers, pp. C12-1—C12-16 (The Aluminum Ass., New York, N.Y., Mar. 1973).

Key words: Color; gloss; porcelain enamel on aluminum; weather resistance.

An exposure text of porcelain enamels on aluminum was initiated by the National Bureau of Standards and the Porcelain Enamel Institute in 1964. The enameled specimens were returned from exposure sites at Kure Beach, N.C.; Washington, D.C.; New York, N.Y.; Montreal, Canada; and Los Angeles, Calif., to the laboratory at NBS to be measured for changes in gloss and color after 6 months, and 1, 3, and 5 years' exposure. The 5-year data indicate no change in enamel thickness and good color retention at all sites except Kure Beach.

**13384.** Moore, R. T., **Penetration resistance tests of reinforced concrete barriers.** *NBSIR 73-101,* 83 pages (Dec. 1972). (Available as COM 73-10867 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Barrier penetration; intrusion detection; physical security; reinforced concrete.

This report describes the results of a series of penetration tests on six concrete slabs. The tests were conducted at the U.S. Army Corps of Engineers Construction Engineering Research Laboratory in Champaign, Ill., during the period October 31 through November 3, 1972. Several alternative methods of attack were employed, and the time to penetrate, and in some instances, to produce a 96-inch$^2$ opening, was measured, and estimates were developed regarding the acoustic, ultrasonic and vibrational disturbances produced by the attacks.

Depending upon the attack technique, a man-passable opening can be made in 4-inch thick reinforced concrete in times ranging from 4 to nearly 15 minutes. The corresponding times for 8-inch thick reinforced regular concrete range from about 7 to 25 minutes and from about 20 to 30 minutes fibrous concrete.

With the exception of the diamond core drill, detection should be relatively easy by the combined acoustic, ultrasonic or vibrational disturbances produced by the attacks even though not all techniques produce all three types of disturbances.

**13385.** Berg, C. A., **Energy conservation through effective utilization,** *NBSIR 73-102,* 53 pages (Feb. 1973). (Available as COM 73-10856 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Effective utilization; energy conservation.

In two major sectors of the economy (building services and industrial processes), accounting for approximately 75 percent of total national energy consumption, energy utilization is found to be inefficient. It is estimated that in these two sectors, as much as 25 percent of the energy consumed annually by the nation as a whole may be lost through ineffective practices. Possible reasons for existence of ineffective utilization are considered, and possible means of improving effectiveness of utilization are discussed. Three possible levels of effort to promote effective utilization of energy are identified; one promotes effective use of present fuels in present processes; the second promotes utilization of presently unused energy sources; the third promotes more effective investment of energy in durable and maintainable products.

Substantial latitude for improvement of effectiveness is shown to be realizable through technological efforts at these three levels. It is finally recommended that a national program, incorporating efforts at the three levels identified, be undertaken with the ultimate goal of creating and implementing a technology of improved energy utilization.

**13386.** Shaver, J. R., Masters, L. W., Reichard, T. W., Pielert, J. H., **Environmental evaluation of polyurethane foam core sandwich panel construction,** *NBSIR 73-105,* 47 pages (Dec. 1972). (Available as PB 219118 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accelerated aging; compression; environmental conditions; flexure; housing system; Operation BREAKTHROUGH; polyurethane foam; sandwich construction; wall system.

An environmental evaluation of a sandwich panel bearing wall system for use in one of the Operation BREAKTHROUGH housing systems is described. Two samples of polyurethane foam core sandwich construction and four full size wall panels were evaluated.

The samples of the sandwich construction were used to evaluate the effect of extreme temperature and moisture on this type of sandwich construction. The full size panels were used to determine the behavior in service considering the effects of adverse environmental conditions on ultimate strength and mode of failure.

**13387.** Unassigned.

**13388.** Yokel, F. Y., **Study of the local resistance of conventional plywood subflooring to concentrated load,** *NBSIR 73-116,* 64 pages (Mar. 26, 1973). (Available as PB 220432 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Concentrated-load capacity; evaluation criteria; floors; hardboard; load capacity; Operation BREAKTHROUGH; performance criteria; plywood subflooring; subflooring; underlayment; wood-frame construction.

Five conventional plywood floor systems, constructed in accordance with the requirements of the FHA "Minimum Property Standards" were tested under concentrated loads in order to compare their performance with that stipulated by performance criteria developed on the basis of anticipated occupancy loads.

In 24 out of 26 tests the performance of the floor systems exceeded that stipulated by the criteria. Data on failure loads, load-deflection characteristics and failure modes are presented and discussed.

**13389.** Yancey, C. W., Somes, N. F., **Structural tests of a wood-frame housing module,** *NBSIR 73-121,* 111 pages (Mar. 26, 1973). (Available as COM 73-10860 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Deflection; housing; laboratory; module; racking; stiffness; strength; structural tests; sustained load; transportation; vibration; wood-frame.

This paper reports the results of tests to determine the structural strength and stiffness characteristics of a prototype wood-frame volumetric housing module. The series of six structural tests was performed at the NBS Structures Laboratory, Gaithersburg, Md., subsequent to a trial rail shipment, which included several coupling impacts. This report refers to the transportation study only to the extent that it concerns the module, and in particular, its condition at the start of the structural tests. The total sequence of the tests closely simulated the experience of a typical module as it undergoes manufacture, transportation, erection and in-service loading.

**13390.** Cattaneo, L. E., Yokel, F. Y., **Structural tests of mechanical connections for concrete panels,** *NBSIR 73-126,* 118 pages (Nov. 1972). (Available as PB 219124 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Concrete panels; connections; ductility; floor diaphragms; housing systems; insert connectors; Operation BREAKTHROUGH; precast concrete.

Structural evaluation tests were performed on prototype steel insert connectors proposed for joining floor and wall panels of a precast concrete housing system included in Operation BREAKTHROUGH. Descriptions are given of 25 tests conducted with 5 different types of connectors. Specimen connections were laboratory tested under simulated design loading conditions to evaluate their load capacity and ductility.

**13391.** Waksman, D., Skoda, L. F., Clark, E. J., Godette, M., **Evaluation of lead paint hazard elimination methods, Part II,** *NBSIR 73-127,* 77 pages (Mar. 1973). (Available as PB 213352 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Deleading methods; lead paint poisoning; performance; properties.

Four major classifications of procedures that should be considered when selecting a method for the elimination of the lead paint hazard are analyzed in this report. They are: surface repair methods, surface finish methods, cover up methods with unfinished membrane materials, and cover up methods with prefinished rigid materials. The attributes associated with each type of method were considered and analyzed in terms of inaccessibility of the leaded paint and implementation considerations. Recommendations are made for the in-use performance properties of surfaces.

**13392.** Halsey, N., Mitchell, R. A., Mordfin, L., **Evaluation of GRP rod and rope materials and associated end fittings,** *NBSIR 73-129,* 87 pages (Dec. 1972). (Available as AD 759931 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Aeolian vibration, simulated; composite materials; end fittings for GRP rod and rope; grips, guy; guys, antenna; humidity, effects on GRP; mechanical properties of GRP; pultruded rod; reinforced plastics, rod and rope; rope, GRP; static fatigue of GRP.

An extensive and varied test program was carried out on four GRP rod and rope materials to evaluate tensile strengths, moduli of elasticity, flexibility at low temperatures, effects of simulated Aeolian vibration, and stress-rupture properties at moderate elevated temperatures both with and without high humidity. The effects of elevated temperature on long-term storage capabilities were investigated, and diameter-temperature relationships were established for avoiding buckling due to storage in a coiled condition.

The performances of five commercially available end fittings on these materials were examined in terms of the breaking loads attained in tensile tests. Using finite-element analyses, an improved end fitting was developed which is capable of approaching the true tensile strengths of two of the GRP materials. An experimental stress analysis of the improved fitting was performed.

**13393.** Pezoldt, V. J., Persensky, J. J., **Human factors evaluation of a voice encoding system,** *NBSIR 73-131,* 57 pages (Mar. 1973). (Available as COM 73-10863 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Feasibility; keyboard alternative; man-machine interface; postal sorting; voice encoding.

The feasibility of employing voice encoding as an alternative to keyboard entry for postal sorting application was investigated in two phases. Phase I was a simulated parcel sorting situation. Phase II was performed to determine man-machine interface limitations. The results of this study led to the following conclusion and recommendations. Voice encoding would be of limited value to high speed parcel sorting unless it was used only during slack periods or the current facer and keyer both use a VES. Voice encoding could be applied to other sorting tasks. USPS tasks should be analyzed for the possibility of such application. Other voice encoding systems should be evaluated. These systems should have single command training capability, a cancel capability accessed by other than a unique verbal command, and should require infrequent system training.

**13394.** Son, B. C., **Fire endurance tests of steel sandwich panel exterior wall and roof/ceiling constructions,** *NBSIR 73-135,* 38 pages (Dec. 1972). (Available as PB 221310 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Exterior wall; fire endurance; fire test; housing systems; Operation BREAKTHROUGH; paper honeycomb; roof/ceiling assembly; structural sandwich panel.

As part of the evaluation of a housing system proposed under Operation BREAKTHROUGH, fire endurance tests were performed at the National Bureau of Standards on an exterior wall assembly and a roof/ceiling assembly. Both constructions were assemblies of sandwich panels composed of a paper honeycomb core with sheet steel facings.

The test method was in accordance with the requirements of ASTM E 119, Standard Methods of Fire Tests of Building Construction and Materials, for loadbearing structures. The applied live load was 237 pounds per linear foot (plf) for the wall assembly and 28.6 pounds per square foot (psf) on a 13 ft 5 in span for the roof/ceiling assembly. The results of these tests are valid only for walls and roof/ceilings of such constructions described in this report and loaded at or below the stress levels developed by these loadings.

The fire endurance of the wall assembly was 7 min 50 sec; and the roof/ceiling, 9 min 09 sec. In both cases, the failure was due to a maximum temperature rise of 181 °C (325 °F) above the initial temperature on the unexposed surface.

**13395.** Craw, A. R., **Time series forecasting of highway accident fatalities,** *NBSIR 73-138,* 37 pages (Mar. 1973). (Available as COM 73-10868 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Exponential smoothing; fatalities; highway accidents; time series.

Using twelve years of time series data on highway fatalities, the methodology currently employed by the National Highway Traffic Safety Administration (NHTSA) to forecast the annual (calendar year) total of highway accident fatalities were compared with those obtained by several computer routines based on exponential smoothing techniques and available at the National Bureau of Standards. The use of unadjusted and seasonally adjusted data was also examined.

It is found that there is no coercive evidence to lead to abandoning the present NHTSA methods in favor of readily available computer routines based on exponential smoothing methods.

Of the methods examined in this study, the best results were obtained with the EXPSMOOTHING routine using unadjusted fatality data.

**13396.** Son, B. C., **Fire endurance test of plywood-faced exterior walls for single family housing,** *NBSIR 73-140,* 24 pages (Mar. 1973). (Available as PB 22026/5 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; housing systems; interdwelling wall; Operation BREAKTHROUGH; single wall.

As a part of the testing and evaluation activities in Operation BREAKTHROUGH, a standard fire test conforming to ASTM E 119 was performed at the National Bureau of Standards on a wall assembly where half represented a nonbearing single exterior wall (as found in single family detached housing) and the other half represented a nonbearing double wall for an interdwelling separation which would occur at the interface of two parallel adjacent modules. Each wall contained a layer of gypsum board as an interior (room) surface and a layer of plywood as an exterior surface, and was framed with nominal 2 × 4 in wood studs on 16 in centers. No structural load was applied during the test.

The fire endurance of the single wall was 43 min. The initial mode of failure was by excessive average temperature rise on the unexposed surface of the wall.

Although the test results of the interdwelling wall were inconclusive, its fire endurance was considered to be 1 hr. 02 min. This fire endurance was based on visual observation during the test and was the time when the gypsum board on the unexposed side was observed to separate from the wood studs.

**13397.** Shoub, H., Son, B. C., **Fire endurance tests of plywood on steel joist floor assemblies, with and without ceiling,** *NBSIR 73-141,* 37 pages (Mar. 1972). (Available as PB 220430/3 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire test; floor assembly; floor-ceiling assembly; housing systems; modular construction; Operation BREAKTHROUGH; steel framing; steel joist floor.

Fire endurance tests were conducted on two floor/ceiling assemblies intended for use in modular housing. One assembly simulated the combination of the floor of an upper story module with the ceiling assembly of the module beneath; the other assembly, the floor of a first floor module over a ceilingless crawl or foundation space.

The floors were of plywood deck with vinyl or carpet overlay on light gage steel "C" joists. In the floor-ceiling assembly, the ceiling was separately supported on its own joists, contained simulated HVAC (Heating, Ventilation, and Air Condition) duct work and a layer of glass fiber batt insulation. During the tests which were conducted generally in accordance with the requirements of ASTM E 119-71, Fire Tests of Building Construction and Materials, the floors were loaded to represent the dead weight of structural parts bearing on them and a live load application of 40 psf. The test results are valid only for floors of similar construction loaded at or below the stress level developed by this loading.

Failure of the floor with the protective ceiling assembly occurred by flame-through to the unexposed surface at 29 min, with extensive structural failure (collapse under load) following at 33 min. The unprotected floor over the crawl space had a flame-through at 3 1/4 min, and structural failure following at 3 3/4 min.

**13398.** Kusuda, T., **Climatological data at the proposed prototype sites in the United States for the evaluation of HUD Operation BREAKTHROUGH housing systems,** *NBSIR 73-144,* 137 pages (Apr. 10, 1973). (Available as PB 220849/4 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Air contamination; design conditions; earthquake risk; evaluation; ground temperature; humidity; noise level; Operation BREAKTHROUGH; precipitation; solar radiation; temperature; wind direction; wind speed.

The purpose of this report is to provide preliminary information on site climatology useful for the design and evaluation of HUD Operation BREAKTHROUGH experimental building systems. In order to evaluate the design as well as the performance of building systems, the following environmental parameters are considered essential and are included in this report for each of the selected sites: temperature, humidity, wind speed and direction, precipitation (snow and rain), solar radiation (direct and diffuse), ground temperature (depth and frost), background noise level, air contamination, and earthquake risk.

**13399.** Rossiter, W. J., Jr., **Outdoor performance of plastics. Z. Final update of weathering data,** *NBSIR 73-146,* 104 pages (Mar. 1973). (Available as COM 73-10989 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Manufacturing Chemists' Association (MCS); performance of plastics outdoors; plastics; weathering of plastics.

Twenty plastics samples have been weathered in Arizona, Florida, and Washington, D.C. for 72 months. The weathering of these samples has been followed by measuring changes in the specimen's color, tensile, flexure, gloss, and haze properties. Computer-generated graphs of these changes with time are presented.

**13400.** Unassigned.

**13401.** Yokel, F. Y., Reichard, T. W., **Evaluation of the column connections used in a precast concrete modular housing system,** *NBSIR 73-148,* 90 pages (Mar. 26, 1973). Superseded by NBS Technical Note 811 (in press). (Available as PB 220366/7 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Building system; column connection; concrete triaxial strength; ductility; neoprene bearing pad; Operation BREAKTHROUGH; performance tests; precast concrete; structural design.

The column connections used in a housing system employing stacked precast concrete box modules were tested to evaluate their structural performance. The system was proposed for construction in Operation BREAKTHROUGH, a research and demonstration program sponsored by the Department of Housing and Urban Development. The system uses innovative structural design concepts, which include: confinement of the concrete in the vicinity of the column bearings by reinforcing ties in order to increase concrete compressive strength; neoprene pads between column bearings in the upper stories; steel-neoprene-steel sandwich in the lower stories; and a grouted dowel through the center of the columns to provide resistance to tension and shear.

The test program included the following: tests to determine the effect of various bearing pads on the load capacity of the connection; tests to determine the load-deformation characteristics of the neoprene pads; a test to determine the performance of a lower-story connection using a steel-neoprene-steel sandwich and a grouted dowel; and tests to evaluate the strength and ductility of the connections when subjected to a shear force. The test results are presented and interpreted and the findings are summarized.

**13402.** Donaldson, J. R., **On uncertainty in mass measurement,** *NBSIR 73-151,* 10 pages (Mar. 1973). (Available as COM 73-10866 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Mass measurement; random variability; standard deviation; systematic error; uncertainty.

This paper is a review of the factors which determine the total uncertainty of a measured mass value. It explains how to determine the standard deviation of the measurement process, how to combine error terms to provide a realistic estimate of the uncertainty, and how these error terms are propagated through a chain of mass measurements.

**13403.** Craw, A. R., **A summary of the relationships between accident indices and rates following a redefinition of "failure,"** *NBSIR 73-154,* 17 pages (Mar. 1973). (Available as COM 73-10865 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accident indices; accident rates; failure indices; failure rates; highway accidents.

Using Cerrelli's association of "failure" with active involvements in the case of two vehicles accidents, one can define failure indices, accident involvement indices, failure rates, accident involvement rates for 1-vehicle, 2-vehicle and for the union class of 1- and 2-vehicle accidents. This note presents in a condensed form all of the definitions of these measures, and a number of useful relationships and interrelationships that exist between these different measures. These formulae should prove useful in the calculation of the resulting indices and rates and of converting from one set of measures to another.

**13404.** Finkel, P. W., Miller, T. R., **Executive summary of a proficiency test assessment of clinical laboratory capability in the United States,** *NBSIR 73-162,* 9 pages (May 1973). Superseded by NBSIR 73-163. (Available as COM 74-10542 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accuracy; clinical chemistry; hematology; medical usefulness; microbiology, proficiency testing.

The proficiency of a selected sample of physician, hospital and independent laboratories was assessed with respect to their ability to analyze clinical chemistry and hematology samples and to identify microbiological organisms. For the assessment of clinical chemistry and hematology proficiency, the laboratories were grouped and determinations of group accuracy and group precision were made. Further analyses were performed to determine relative accuracy and precision of the techniques presently applied to these groups. There was no significant difference at the 95% confidence level in the accuracy achieved by the various laboratory groups involved in clinical chemistry and hematology analysis. In clinical chemistry, the Medicare-Certified Independent Laboratories, CDC Tested Laboratories and JCAH-Members generally proved more precise than Physicians' Office and Medicare-Certified Hospital Laboratories. However, none of the laboratory groups were sufficiently accurate to permit the monitoring over time of variation in an individual patient's constituent concentrations. It would appear that poor selection of techniques was an important contributor to this low performance level. In hematology the Physicians' Office Laboratories proved to be the least precise of the groups. There was no noticeable difference in precision between participants in the CDC proficiency testing program and nonparticipants. With respect to microbiology, 7.6% of the identifications by laboratories participating in the CDC testing program were incorrect, while 19.4% of all other identifications were incorrect.

**13405.** Son, B. C., **Fire endurance test of a steel sandwich panel floor construction,** *NBSIR 73-164,* 25 pages (Apr. 1973). (Available as PB 221642 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; flame penetration; floor assembly; housing systems; Operation BREAKTHROUGH; paper honeycomb; structural panel.

As a part of the evaluation of a housing system proposed under Operation BREAKTHROUGH, a fire endurance test was performed at the National Bureau of Standards on a floor, made up of sandwich panels consisting of a paper honeycomb core with steel and plywood surfaces, supported on steel joists.

The test method was generally in accordance with the requirements of ASTM E 119, Fire Tests of Building Construction and Materials, for loadbearing floor constructions. The applied live load was 40 psf and the test results are valid only for floors of similar construction loaded at or below the stress level developed by this loading.

Failure occurred by flame-through of the floor assembly in 8 min 45 sec, with structural failure (inability to sustain the applied load) following immediately.

**13406.** Son, B. C., **Fire endurance test on a steel tubular column protected with gypsum board,** *NBSIR 73-165*, 23 pages (Apr. 1973). (Available as PB 221474 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; housing system; multifamily housing; Operation BREAKTHROUGH; single family attached housing; steel tube column.

As a part of the evaluation of housing systems for Operation BREAKTHROUGH a standard fire endurance test was performed at the National Bureau of Standards on a load-bearing steel column construction for use in single-family attached and multifamily low-rise housing. The test method was generally in accord with the requirements of ASTM E 119, Standard Methods of Fire Tests of Building Construction and Materials, for a loaded column. The applied load was 7110 pounds per column and the test results are valid only for columns of such construction loaded at or below the stress level developed by this loading.

The 3 in × 2 in × 3/16 in rectangular hollow tubular steel column was protected with two layers of gypsum board.

The fire endurance of the column assembly was established at 59 min, when structural failure occurred.

**13407.** Son, B. C., **Fire endurance test of an interdwelling double wall construction of paper honeycomb and gypsum board,** *NBSIR 73-166*, 24 pages (Apr. 1973). (Available as PB 222297 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; flame penetration; glass reinforced plastic; housing systems; interdwelling wall; modular construction; Operation BREAKTHROUGH; paper honeycomb; structural panel.

As a part of the evaluation of a housing system proposed under Operation BREAKTHROUGH, a fire endurance test was performed at the National Bureau of Standards on a double wall assembly intended as an interdwelling separation for single family attached housing. Each wall of the assembly contained a core of paper honeycomb surfaced on both sides with glass fabric impregnated with polyester resin, and protective layers of gypsum board.

The test method was generally in accordance with the requirements of ASTM E 119, Fire Tests of Building Construction and Materials. The applied live load was 636 plf on each panel and the results of this test are valid only for walls of similar construction loaded at or below the stress levels developed by this loading.

The fire endurance of the first (fire-exposed) wall panel was 65 min:30 sec, based on flame penetration through cracks and openings formed on the back face of the first wall. The overall fire resistance of the double wall assembly was 79 min when pieces of the structural glass fabric of the front face of the second wall were observed falling into the furnace.

**13408.** Son, B. C., **Fire endurance test of a roof/ceiling construction of paper honeycomb and gypsum board,** *NBSIR 73-167*, 20 pages (Jan. 1973). (Available as PB 222298 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; flame-through failure, structural panel; glass-fabric reinforced plastic; housing systems; Operation BREAKTHROUGH; paper honeycomb; roof/ceiling assembly; structural panel.

In a program of evaluation of various housing systems proposed under Operation BREAKTHROUGH, a fire endurance test was performed at the National Bureau of Standards on a roof/ceiling assembly consisting of a paper honeycomb structural core surfaced both sides with glass-fabric impregnated with polyester resin and outer layers of gypsum board.

The test method was generally in accordance with the requirements of ASTM E 119, Fire Tests of Building Construction and Materials, for loadbearing roof assemblies. The applied load was 15.9 psf and the test results are valid only for roof/ceilings of similar construction loaded at or below the stress level developed by this loading.

Under a loading of 15.9 psf on a 13 ft 5 in span, which produced a stress equivalent to the application of 20 psf on a 12 ft span, failure occurred by flame-through of the roof/ceiling assembly at 37 min 13 sec.

**13409.** Son, B. C., **Fire endurance test of a fiber glass reinforced polyester double wall assembly,** *NBSIR 73-168*, 27 pages (Apr. 1973). (Available as PB 221184 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; glass fiber-reinforced plastic; housing systems; interdwelling wall; Operation BREAKTHROUGH.

As a part of the evaluation of a housing system proposed under Operation BREAKTHROUGH a standard fire endurance test was performed on a double wall assembly comprising a load-bearing interdwelling (party) wall for single family attached housing. The test method was in accordance with the requirements of ASTM E 119, and the applied load was 700 pounds per linear foot (plf) per wall. The test results are valid only for walls of similar construction loaded at or below the stress level developed by this loading.

The double wall, representative of an interdwelling (party wall) separation, was made up of two identical parallel panels from two adjacent modules separated by a 2 1/4 in air space. Each wall assembly contained glass fiber-reinforced polyester (GRP) sheet faces, glued to a corrugated GRP stiffener core. The GRP core members were painted with an intumescent type fire retardant paint and the core spaces were filled with mineral wool insulation.

The fire endurance of the first (fire-exposed) wall was 27 min:25 sec with the initial mode of failure by structural collapse.

The second (unexposed) wall failed at 42 min when a hot (charred) spot was observed on the unexposed surface.

**13410.** Son, B. C., **Fire endurance test of a wood stud interdwelling double wall construction,** *NBSIR 73-169*, 21 pages (Apr. 1973). (Available as PB 221185 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; flame-through failure of walls; housing systems; interdwelling wall; Operation BREAKTHROUGH.

As a part of the evaluation of a housing system proposed under Operation BREAKTHROUGH a standard fire endurance test was performed on a double wall construction representing a non-load-bearing interdwelling wall for single family attached housing. The test was conducted at the National Bureau of Standards and followed the requirements of ASTM E 119, Fire Tests of Building Construction and Materials.

The double wall which represented an interdwelling separation between two adjacent modules, was made up of two identical parallel walls separated by a 1/2 in air space. Each wall con-

tained two layers of fire-rated gypsum board attached to wood stud framing on the dwelling room side.

Since the test assembly represented a nonbearing wall, no load was applied during this test.

The failure of the first (fire exposed) wall occurred at 1 h:17 min when a joint in the second layer of gypsum board opened to allow passage of flame.

The second (unexposed) wall failed at 2 hr 19 min when the temperature rise at one point on the exposed surface exceeded the maximum allowable.

**13411.** Son, B. C., **Fire endurance test of an interdwelling double wall constructed of polyurethane foam-filled sandwich panels,** *NBSIR 73-170,* 27 pages (Apr. 1973). (Available as PB 221193 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; housing systems; interdwelling wall; load failure; modular construction; Operation BREAKTHROUGH; polyurethane foam; toxic gases.

As a part of the evaluation of housing systems for Operation BREAKTHROUGH, a standard ASTM E 119 fire endurance test was performed on a double wall assembly comprising a load-bearing interdwelling (party) wall for single family attached housing.

The test was generally in accordance with the requirements of ASTM E 119, Fire Test of Building Construction and Materials. The applied live load was 678 pounds per linear foot (plf) per wall and the test results are valid only for walls of similar construction loaded at or below the stress level developed by this loading.

The fire endurance of the first (fire exposed) wall, based on structural load failure, was 1 hr and 4 min. The test was discontinued at 1 hr:06 min because of untenable conditions in the test building resulting from smoke and combustion gases released by the polyurethane foam insulation in the wall.

**13412.** Son, B. C., Shoub, H., **Fire endurance tests of double module walls of gypsum board and steel studs,** *NBSIR 73-173,* 32 pages (Apr. 1973). (Available as COM 73-10844 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire tests; housing systems; modular construction; Operation BREAKTHROUGH; steel framing.

Standard fire endurance fire tests were conducted on two 8-ft high by 16-ft long assemblies, each consisting of double modular partition walls. In these tests, the applied loads represented the weight of modules supported by the walls, and other applicable design live loads. The partitions were of gypsum board on metal studs and simulated the juxtaposition of walls of two adjoining housing modules. As each of the parallel module walls was an independent load bearing member both were required to meet a specified fire endurance under the applied load in tests conducted in accordance with the requirements of ASTM E 119-71, Fire Tests of Building Construction and Materials.

The load applied was 1078 pounds per linear foot (plf) per wall and the test results are valid only for walls of similar construction loaded at or below the stress level developed by this loading.

The fire exposed wall of the first test specimen (with 3 in "C" type studs) failed structurally at 42 min and the outer wall failed structurally at 1 hr 13 min. In the second test specimen, with tubular studs for increased strength, the fire exposed wall failed structurally at 1 hr 7 min and the outer wall failed at 1 hr 37 min by passage of hot gas.

**13413.** Quigley, D. F., **USAC transferability,** *NBSIR 73-183,* 71 pages (Apr. 1973). (Available as COM 73-11177 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Information systems; management information systems; municipal systems; technology transfer.

This is a report on the transferability of the USAC program technology. USAC is a Federal Urban Information Sytems Inter-Agency Committee which oversees a program of research and development of municipal information systems. This report examines the transferability of the program results from three perspectives: the technical results achieved *vis-a-vis* its research objectives, the technology products for transfer, and the organizations that could participate in the transfer. Proposals to enhance the transferability of USAC technology are made.

**13414.** Quindry, T. L., **Acoustical evaluation of a single family attached steel-frame modular housing system constructed on an Operation BREAKTHROUGH prototype site,** *NBSIR 73-190,* 21 pages (Apr. 1973). (Available as PB 221189 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Acoustics; noise isolation class; Operation BREAKTHROUGH.

The acoustical performance of a single family attached steel-frame modular housing system was tested on an Operation BREAKTHROUGH prototype site.

Test results are given concerning the noise isolation of interdwelling walls, the noise isolation of intradwelling walls and floor-ceiling assemblies.

**13415.** Quindry, T. L., **Acoustical evaluation of a single family detached honeycomb panel housing system constructed on an Operation BREAKTHROUGH prototype site,** *NBSIR 73-192,* 19 pages (Apr. 1973). (Available as PB 222231 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Acoustics; noise criterion curves; noise isolation class; Operation BREAKTHROUGH.

The acoustical performance of a single family detached honeycomb panel housing system was tested on an Operation BREAKTHROUGH prototype site.

Test results are given concerning the noise isolation of intradwelling walls and the noise levels within living units.

**13416.** Ludtke, P. R., **Development of insulation transfer-standards using a flat plate calorimeter,** *NBSIR 73-301,* 43 pages (Mar. 1973). (Available as COM 73-10762 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Calorimeters; fiber glass; foam insulation; insulation transfer-standard; multilayer insulation; thermal insulation; transfer standards.

This program was initiated to develop insulation transfer-standards to be used for evaluating calorimeters at different locations throughout the country. Various types of insulation materials were evaluated for use as transfer-standards. Samples were prepared for preliminary evaluation from selected candidate insulation materials. A 30.5 cm diameter double guarded flat plate calorimeter at MSFC was provided for testing. The calorimeter was checked and the boiloff-gas instrumentation updated. Thermal conductivity screening tests were conducted using liquid nitrogen on open and closed cell foam and fiber glass samples. The mean thermal conductivity values of the samples tested during the screening tests are presented. Compliance with the proposed ASTM Standard Method of Test for Heat Flux Through Evacuated Insulations was stressed.

**13417.** Gans, W. L., Nahman, N. S., **Fast Fourier transform implementation for the calculation of network frequency domain transfer functions from time domain waveforms,** *NBSIR 73-303,* 53 pages (Dec. 1972). (Available as COM 73-10509 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Discrete Fourier transform; fast Fourier transform; frequency spectra, discrete; network transfer function; time domain waveform; transfer function.

This report is concerned with the software applications of the fast Fourier transform algorithm to the relationship between time domain waveforms and frequency domain spectra. The first chapter is devoted to a description of the discrete Fourier transform and the fast Fourier transform. Chapter 2 contains the text and a brief description of all FORTRAN II programs utilized in connection with this work. All computation was performed on the in-house time share computing system in the NBS facilities, Boulder, Colo. In Chapter 3, problems encountered using the fast Fourier transform algorithm are discussed, an example of a time domain to frequency domain calculation is presented, and future developmental considerations are mentioned. In addition, Appendix A contains a detailed example aimed at disclosing the inner mechanisms of the fast Fourier transform algorithm.

**13418.** Sindt, C. F., **Insulation of liquid oxygen dewars,** *NBSIR 73-308,* 44 pages (Apr. 1973). (Available as AD 763325 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Cryogenic insulation; insulation; LOX dewars; microspheres; polyurethane foam.

The Navy has experienced failure of vacuum insulation in dewars used for storage and handling of liquefied breathing oxygen for aircraft pilots. Because of the vacuum insulation failures, a search was made for a more rugged insulation that has thermal performance similar to the currently used vacuum with multilayer or powder. No system was found that compared in thermal performance and did not require a vacuum. Two systems were experimentally evaluated that did not require vacuum. One was polyurethane foam with an intermediate fiber glass shell and the other was glass bubbles in argon gas at one atmosphere pressure. The polyurethane foam system was successful in that no cracks penetrated to the outside surface; however, the average thermal conductivity was 160 $\mu$W/cm-K which is about 15 times greater than vacuum and powder. The glass bubbles in argon gas was also successful since the argon gas pressure always remained high enough to prevent air and moisture from entering the insulation through small leaks in the outer shell. The thermal performance was poorer than the polyurethane foam. The average thermal conductivity was 212 $\mu$W/cm-K or about 20 times greater than for the same glass bubbles in a vacuum.

**13419.** Thurber, W. R., Lewis, D. C., Bullis, W. M., **Resistivity and carrier lifetime in gold-doped silicon,** *NBSIR 73-128,* 56 pages (Jan. 31, 1973). (Available as AD 760150 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Carrier lifetime; gold-doped silicon; resistivity; semiconductor characterization; silicon.

This report describes the current status of a continuing study of the electrical properties of gold-doped silicon. Room temperature resistivity and Hall effect measurements were made on many sets of gold-diffused boron- or phosphorus-doped silicon wafers for a wide range of initial resistivities of both types. The general suitability of the proposed model was verified although an apparent discrepancy still remains between total and electrically active gold as confirmed by resistivity data as a function of gold density for phosphorus-doped silicon. Electrical measurements were made to study the activation energies of the gold donor and acceptor. In addition, the activation energy of the gold-coupled shallow acceptor in the proposed model was observed. The values found were in good agreement with other reported observations of these levels. In the application of the surface photovoltage method to the measurement of minority carrier lifetime, it was found that the optical absorption coefficients needed in the analysis of the data were dependent on the heat treatment given to the specimen. The uncertainty in diffusion length was determined to be about 2 $\mu$m which placed an effective lower limit on lifetime measurements of about 15 ns in $p$-type and about 50 ns in $n$-type silicon. An analysis of the use of the surface photovoltage method for lifetime measurements in thin epitaxial layers is included as an appendix. The reverse recovery (RR) technique for measuring lifetime was examined and it was observed that the dependence of diode storage time on the ratio of forward to reverse current varied with the base width of the diode studied. While theory and experiment for open circuit voltage decay (OCVD) were in agreement for long base width diodes, correlation for short base diodes was less satisfactory; this study is continuing. Both the RR and OCVD techniques give the same value of lifetime for long base diodes, but agreement for short base diodes is not as good. Additional entries are included as a supplement to an earlier bibliography on the properties of gold-doped silicon.

**13420.** Stoltenberg, R. E., **RF null detector NBS/SND,** *NBSIR 73-302,* 88 pages (June 1973). (Available as COM 73-10869 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Detector; phase sensitive; RF null detector.

This report describes an ultrasensitive receiver for detecting low-level rf signals in the nanovolt region. The primary purpose of the instrument is to detect the balance condition in rf bridges; however, it is useful in any comparison measurement in which two or more signals can be adjusted in phase and magnitude such that their summation results in a null.

The receiver frequency is determined by individual plug-in units. Units have been built for selected frequencies from 100 kHz through 30 MHz. Detection is accomplished by double conversion. The first converts the signal of interest to a common intermediate frequency; the second performs a dual synchronous (homodyne) conversion. The dual detectors are sensitive to signals in quadrature with each other. A reference voltage synchronous with the null signal is required. Thus, the dual detection provides an indication of both the phase and the magnitude of the null unbalance.

The output of each detector is displayed on a zero-center meter, thus indicating the direction of unbalance as well as the magnitude. This information is also available at a rear panel jack for use in servo control of the external system.

Gain adjustment over a 90 dB range is provided by a single front panel control. Phase adjustment to compensate for differential phase delay between the reference and null signals is accomplished with a front panel 360° continuous phase control.

**13421.** Unassigned.

**13422.** Milligan, D. E., Jacox, M. E., **Matrix isolation spectroscopy,** Chapter 1 in *MTP (Medical and Technical Publishing) International Review of Science, Physical Chemistry Series One, Vol. 3, Spectroscopy,* D. A. Ramsay, Ed., pp. 1-32 (Butterworth & Co., Ltd., London, England and University Park Press, Baltimore, Md., 1972).

Key words: Atomic spectra; electronic spectra; free radicals; high-temperature species; matrix isolation; molecular ions; reactive molecules; rotation in matrices; vibrational spectra.

Studies of the infrared and ultraviolet spectra of atoms and molecules isolated in inert solid matrices at cryogenic temperatures are reviewed, with emphasis on the basic principles of the technique and on publications during the period 1969-1971.

**13423.** Hudson, R. P., **Book: Principles and application of magnetic cooling,** *Series in Low Temperature Physics* **2**, 1-230 (North-Holland Publishing Co., Amsterdam, The Netherlands, 1972).

Key words: Adiabatic demagnetization; cryogenics; cryothermometry; magnetic cooling; magnetism.

Magnetic cooling is discussed in terms of basic thermodynamic principles, then supplemented by a review of paramagnetism theory, and descriptions of experimental techniques (including thermometry) involved in applying the magnetocaloric effect to real systems.

**13424.** Wong, C. Y., Tamura, T., Marshak, H., Langsford, A., **Effects of nuclear collectivity on the total neutron cross section,** *Particles Nucl.* **4**, 163-174 (1972).

Key words: Coupled channel calculations; holmium$^{165}$; nuclear collectivity; nuclear Ramsauer effect; optical model; total neutron cross section.

A study is made of the effect of the nuclear collectivity on the variation of the total neutron cross section with respect to the incident energy ranging from 4 to 20 MeV. It is found that the higher the collectivity, the smoother is the excitation function, for both deformed and vibrational nuclei. This feature is understood qualitatively in terms of the nuclear Ramsauer effect and is explained quantitatively by coupled-channel calculations. These calculations further reveal that deformed nuclei have larger total cross sections and smoother variations than do the vibrational nuclei. For vibrational nuclei, it is also found that the quadrupole deformation has a slightly larger effect on the smoothness than does the octupole deformation, if they have the same deformation parameter.

**13425.** Ehlers, V. J., Gallagher, A., **Electron excitation of the calcium 4227-Å resonance line,** *Phys. Rev. A* **7**, No. 5, 1573-1585 (May 1973).

Key words: Calcium; electron excitation.

We have measured the optical-excitation function and polarization of the 4227-Å line, using crossed electron and calcium beams, for electron energies from threshold to 1400 eV. In the high-energy region, from 100-450 times the threshold energy, we have used the Bethe theory to normalize our experimental results. An excellent signal-to-noise ratio combined with ~ 0.3-eV full width at half-maximum electron-energy resolution has enabled observation of structure in the excitation function and polarization curves below 5 eV. We observed a threshold polarization limit of (98 ± 3)%, consistent with the expected + 100%. The data are also consistent with a logarithmic approach to a high-energy polarization of − 100%.

**13426.** Kirchhoff, W. H., Lide, D. R., Jr., **Microwave spectrum, dipole moment, and quadrupole coupling constant of trifluoramine oxide,** *J. Chem. Phys.* **51**, No. 1, 467-468 (July 1, 1969).

Key words: Dipole moment; hyperfine structure; microwave spectrum; quadrupole coupling; Stark effect; symmetric top; trifluoramine.

The microwave spectrum of trifluoramine oxide, $NF_3O$, has been observed and is consistent with a symmetric top structure for the molecule. The dipole moment has been measured from the Stark effect of the $K = 1, J = 1 \rightarrow 2$ transition and its value is $0.0390 \pm 0.0004$ Debyes where the uncertainty indicated is twice the standard error obtained from a least squares fit of the data. The quadrupole coupling constant of the nitrogen nucleus was calculated from the hyperfine splitting of the $K = 1, J = 1 \rightarrow 2$ transition. Its value is $eqQ = -1.52 \pm 0.15$ MHz where the uncertainty is based on an estimated uncertainty of 0.05 MHz in the measured hyperfine splitting.

**13427.** Kirchhoff, W. H., **Microwave spectroscopy—a molecular probe,** *Ind. Res.* **12**, No. 2, 38-41 (Feb. 1970).

Key words: Chemical analysis; dipole moment; microwave; molecular structure; radio astronomy.

A brief state-of-the-art description of microwave spectroscopy is presented. The discussion includes a description of those molecular properties which may be derived from a microwave spectrum, the physical model describing the origin of a microwave spectrum and a discussion of some of the potential uses of microwave spectroscopy as a tool for chemical analysis.

**13428.** Flynn, H. G., Cook, R. K., **The effects of sonic boom and similar impulsive noise on structures,** *Environmental Protection Agency Report No. NTID300.12*, 19 pages (available as PB 206725 from the National Technical Information Service, Springfield, Va. 22151, Dec. 31, 1971).

Key words: Damage by sonic booms; noise pollution; sonic boom.

This report is a review and summary of recently published studies on the effects of sonic booms, mainly physical and financial effects on property. It has been prepared in partial response to Title IV—Noise Pollution, of the Clean Air Amendments of 1970 (Public Law 91-604). It will be published and distributed, concurrently with its presentation to the President and Congress, by the Environmental Protection Agency. A bibliography of recent papers and studies on the damage done by sonic booms is included.

**13429.** Yakowitz, H., Jacobs, M. H., Hunneyball, P. D., **Analysis of urban particulates by means of combined electron microscopy and x-ray microanalysis,** *Micron* **3**, 498-505 (1972).

Key words: Air pollution; composite dust; electron microanalysis; electron microscopy; submicrometer; urban particulates.

Particles from four samples of urban particulate matter collected in the U.S.A. were analysed by combined electron microscopy and microanalysis (EMMA). In the case of material collected at Baltimore, Md., lead was found to be present only in particles ranging from 0.05 $\mu$m to about 0.3 $\mu$m in size. The lead bearing particles did not seem to associate with other particles. Analysis of a fly ash specimen showed no qualitative or significant quantitative variation in chemistry as a function of size for the most prevalent type of particle found. Since it may be crucial to have information about particles smaller than 0.5 $\mu$m in air pollution studies, EMMA should be included with spectrometric analysis, x-ray diffraction, scanning electron microscopy and electron probe microanalysis as a primary tool for particulate analysis.

**13430.** Mihalas, D., Hummer, D. G., **Analyses of light-ion spectra in stellar atmospheres. III. Nitrogen III in the O stars,** *Astrophys. J.* **179**, No. 3, 827-845 (Feb. 1, 1973).

Key words: Dielectronic recombination; doubly ionized nitrogen; emission lines; O-stars; stellar atmospheres; stellar spectra.

An analysis of the N III emission lines in O stars has been carried out on the basis of a detailed solution of the coupled statistical-equilibrium and transfer equations for a multiline, miltilevel, multi-ion ensemble. Our calculations, using static, plane-parallel models reproduce successfully the observed emission at λλ4634, 4640, 4641 ($3p\ ^2P^0 - 3d^2D$) and absorption at λλ4097, 4103 ($3s\ ^2S - 3p\ ^2P^0$). The $^2P^{0-2}\ D$ multiplet is found to come into emission at the observed temperature for both main-sequence and low-gravity objects. The equivalent widths of the emission lines agree very well with those measured for the class of Of stars thought to have compact atmospheres, i.e., those classified as O((f)) by Walborn. In these stars the basic physical mechanism responsible for this phenomenon is the overpopulation of $3d$ by means of dielectronic recombinations from the low-lying $2s2p(^1P^0)3d$ autoionizing states with cascades $3d \rightarrow 3p$. The $3p$ state is drained by the "two-electron jumps" coupling $3p$ to the $2s2p^2(^2S,^2P,^2D)$ states, thus presenting emission in the $2s - 3p$ lines. $3s$-$3p$ lines. The possible importance of the Swings mechanism to the fully developed Of stars (in Walborn's sense) is pointed out, and the irrelevance of the Bowen mechanism to all Of stars is firmly demonstrated. The fact that the N III emission lines can be produced in static nonextended atmospheres in radiative equilibrium has the far-reaching significance that the presence of emission lines in a spectrum is not in itself sufficient evidence for the existence of a stellar chromosphere (i.e., an extended, nonradiatively heated region).

**13431.** Ku, H. H., Kullback, S., **Analysis of multidimensional contingency tables: An information theoretic approach,** *Contributed Papers 37th Session of the International Statistical Institute, London, England, Sept. 3-11, 1969*, pp. 156-158 (Sept. 11, 1969).

Key words: Contingency table; estimation of cell frequencies; hypothesis testing; information theory; interaction; residual analysis.

The principle of minimum discrimination information estimation is described and used for the analysis of multidimensional contingency tables. All classical hypothesis for contingency tables can be generated by the use of this principle and considered as "generalized" independence hypotheses when certain marginals are considered as fixed. The analysis is given in terms of effects and interactions. The practice of residual examination is stressed.

**13432.** Tate, E. L., **Anglo-American code implementation,** Paper in *Advances in Librarianship* **3,** 167-194 (Seminar Press, Inc., New York and London, 1972).

Key words: Anglo-American cataloging rules; cataloging rules; main entries.

"Anglo-American Code Implementation" relates the impact of the code on librarians and the effects it has had on the library world.

**13433.** Jespersen, J. L., Fey, L., **"Time-telling" techniques,** *IEEE Spectrum* **9,** No. 5, 51-58 (May 1972).

Key words: Automatic vehicle location; dissemination of time and frequency; portable clocks; radio propagation; satellite time dissemination; television time and frequency dissemination; time-frequency; time signal noise; system designs; transfer standards.

A brief, historical development of astronomical time scales and their use in navigation, including the present use of an atomic time scale. Frequency standards are compared in terms of accuracy, stability, and practical parameters such as cost.

Time and frequency dissemination methods are treated, including radio propagation effects, factors involved in precise time broadcasts, and use of radio navigation systems for time broadcasts. Various artificial satellite time broadcast techniques are compared. TV time techniques are discussed, as well as portable clock use and other specialized methods. The various time dissemination techniques are compared according to various parameters of interest to the user.

Some basic similarities of systems employing time and frequency are pointed out. Growing complexities of systems requiring time and frequency as an integral part are noted. This generates pressure toward diversification of the designer but emphasizes the need for further integration of time and frequency technology.

**13434.** Dillon, T. A., Stephenson, J. C., **Effect of the straight path approximation and exchange forces on vibrational energy transfer,** *J. Chem. Phys.* **58,** No. 9, 3849-3854 (May 1, 1973).

Key words: $CO_2$; exchange forces; hydrogen halides; line widths; straight path; vibrational energy transfer.

A wide variety of theories exist for calculating fundamental molecular collision processes such as line broadening or energy transfer rates. All of these theories involve evaluation of a "phase" integral or Fourier transform of the intermolecular potential. In this paper we consider two major sources of error that can occur in the evaluation of phase integrals. "Universal" phase integrals calculated in a straight path model are compared with calculations based on trajectories determined by solution of classical orbit equations. Serious discrepancies are pointed out and practical computational alternative is suggested. A simple empirical model for exchange forces is introduced in calculations of linewidths and $V$-$V$ transfer for hydrogen halides in a $CO_2$ atmosphere. These calculations show that exchange forces can have a large effect but that the simple procedure of adding "a short range" contribution to a cross section calculated from attractive multipolar forces gives a totally incorrect picture.

**13435.** Jespersen, J. L., Blair, B. E., Gatterer, L. E., **Characterization and concepts of time-frequency dissemination,** *Proc. IEEE* **60,** No. 5, 502-521 (May 1972).

Key words: Dissemination of time and frequency; portable clocks; radio propagation; satellite time dissemination; television time and frequency dissemination; time signal noise; time-frequency system designs; transfer standards.

Fundamental considerations that arise in designing a time or frequency dissemination system, are discussed and some dissemination methods are surveyed. A section on "Signal design for time and frequency dissemination" briefly summarizes radio propagation characteristics, discusses time signal format design, and considers how noise affects time and frequency signals.

We point out fundamental techniques of time and frequency dissemination and describe similarities between systems for time dissemination and navigation. The use of synchronous satellite transponders and commercial television systems for time dissemination is emphasized because of their great promise. No attempt is made to cover every existing dissemination system; some systems are treated elsewhere in this *Special Issue on Time Frequency*. The concluding section gives three categories of users according to their required accuracy and shows typical systems which can provide desired accuracies. Various dissemination techniques are charted and evaluated in terms of salient characteristics such as accuracy, geographical coverage, cost factors, and others. To alleviate an existing frequency spec-

trum problem, we suggest that designers of communication and navigation systems consider opportunities for including time and frequency dissemination in their systems.

**13436.** Fey, L., **A time code for the Omega worldwide navigation system,** *Proc. IEEE* **60,** No. 5, 630 (May 1972).

Key words: Omega; precision time; time broadcasts; time code; VLF timing.

Time-of-day information could be added to the signals of the Omega worldwide VLF navigation system by means of a digital code. This could be valuable in resetting precision clocks and in monitoring them for malfunction. Also, Omega's worldwide coverage could then provide timing for automatic recording of data, such as geophysical information, in remote locations.

**13437.** Phelps, A. V., **Collision cross sections for electrons with atmospheric species,** (Proc. IAGA Symp. on Aurora and Airglow, Moscow, Aug. 1971), *Ann. Geophys.* **28,** No. 3, 611-625 (1972).

Key words: Atmospheric gases; cross sections; electron-ion recombination; electrons; review of data.

Recent laboratory measurements have yielded much detail concerning cross sections for the elastic and inelastic scattering of electrons by stable atmospheric species. Measurements of the energy and angular distributions of inelastically scattered electrons have yielded cross sections for excitation of the principal levels of $N_2$, $O_2$ and He and for the distribution of secondary electron energies resulting from collisional ionization of these gases. Electron beam measurements of cross sections for the production of radiation from $N_2$, $O_2$ and $N_2^+$ provide data of direct applicability to calculations of auroral intensities, etc. Similar data are also obtained from measurements of electron induced fluorescence. Swarm experiments provide cross section data for vibrational and rotational excitation of $O_2$ and $N_2$ at electron energies below about 1 eV. Afterglow and shock tube measurements have yielded the electron energy and temperature dependence of the electron-ion recombination for a few positive ions. Theoretical calculations of the cross sections for excitation of atomic oxygen and nitrogen are particularly important since laboratory measurements are not generally available.

**13438.** Frommer, M. A., Murday, J. S., Messalem, R. M., **Solubility and diffusivity of water and of salts in an aromatic polyamide film,** *Eur. Polym. J.* **9,** 367-373 (1973).

Key words: Aromatic polyamide membranes; desalination; diffusion; membranes; NMR; permeation in polymers; polymeric films; reverse osmosis; salt-polymer interactions.

The solubility and the diffusivity for water and NaCl in a fully aromatic polyamide (PA) film have been determined. From these the "intrinsic permeability characteristics" of this polymer have been calculated and its suitability for desalination by reverse osmosis is compared with that of the commonly used cellulose acetate (CA). It has been found that, although the solubility of NaCl in the PA film is higher than that in a CA film, PA membranes will reject salt better than CA membranes having identical structure and morphology. This is because the diffusivity of NaCl through the PA film is substantially lower, and the permeability of water through it (as well as the solubility and the diffusivity of water in it) are higher than the comparable values for CA films.

**13439.** Barger, R. L., Sorem, M. S., Hall, J. L., **Frequency stabilization of a cw dye laser,** *Appl. Phys. Lett.* **22,** No. 11, 573-575 (June 1, 1973).

Key words: Dye lasers; laser frequency stabilization; saturated absorption.

A cw dye laser system frequency stabilized to a high-finesse optical reference cavity is described. Laser frequency is servo controlled to the cavity resonance with residual fluctuations less than 50 kHz for short times (20 $\mu$sec) and 100 Hz for long times (10 sec). Drift in absolute laser frequency of about 1.5 MHz/min is observed due to drift of the unstabilized reference cavity. A saturated absorption spectrum of $I_2$ obtained with this system is shown.

**13440.** Stephenson, J. C., **Vibrational excitation and relaxation of the CO($v=1$) and CO($v=2$) states,** *Appl. Phys. Lett.* **22,** No. 11, 576-578 (June 1, 1973).

Key words: Carbon monoxide; infrared lasers; laser pumping of molecules; vibrational energy transfer.

Pulses from a $CO_2$ laser have been frequency doubled in a tellurium crystal and used to optically pump the first vibrational level in room-temperature CO. By monitoring infrared fluorescence from the $v=1$ and $v=2$ states, the rate constant for the process $CO(v=1)+CO(v=1) \rightarrow CO(v=0)+CO(v=2)$ has been determined. Other rate constants involving the $CO(v=1)$ level are also reported.

**13441.** Garvin, D., Hampson, R. F., **Atmospherical modelling and the chemical data problem,** *Proc. AIAA/AMS Int. Conf. on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973,* AIAA Paper No. 73-500, 1-6 (American Institute of Aeronautics and Astronautics, New York, N.Y., 1973).

Key words: Atmosphere; carbon monoxide; chemical kinetics; data evaluation; hydroxyl; nitric acid; nitric oxide; nitrogen dioxide; oxygen atom; ozone; photochemistry; stratosphere.

The chemistry of the stratosphere is determined by 50 to 100 reactions. Accurate data for these reactions are needed as input in models of the chemical dynamics of the stratosphere.

A program to provide reliable rate and photochemical data is described. The present status of some of the reactions involving O, $O_3$, $NO_2$, HO and $HNO_3$ is discussed. Recommended values are given for rate constants for a number of chemical reactions. Reactions requiring further study are indicated.

**13442.** Parker, R. L., **Crystal growth,** Article in *Yearbook of Science and Technology, McGraw-Hill Encyclopedia of Science and Technology,* pp. 158-160 (McGraw-Hill Book Co., New York, N.Y., 1973).

Key words: Crystal growth; crystallization; growth techniques; morphological stability.

The field of crystal growth is briefly reviewed and a number of new developments noted.

**13443.** Ehrlich, M., **Influence of size of $CaF_2$:Mn thermoluminescence dosimeters on $^{60}$Co gamma-ray dosimetry in extended media,** *Proc. 3d Int. Conf. on Luminescence Dosimetry, held at the Danish AEC Research Establishment Risø, Roskilde, Denmark, Oct. 11-14, 1971,* Risø Report No. 249, Part II, 550-560 (Dec. 1971).

Key words: Absorbed dose; $CaF_2$:Mn; $^{60}$Co gamma radiation; extended media; interface; theory.

Absorbed-dose distributions were measured in $CaF_2$:Mn TLD of thicknesses between 0.5 and 3.5 mm, irradiated with an essentially plane-parallel beam of $^{60}$Co gamma rays in media of aluminum (homogeneous case), polystyrene, copper, and lead. Change of average absorbed dose with dosimeter thickness was deduced from the dose distribution. Since dosimeter sizes were of the order of secondary-electron ranges, total energy absorp-



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tion was found to be critically affected by interface effects, which caused a loss of linearity of energy absorbed with dosimeter thickness for polystyrene and lead. A relatively strong asymmetry in the absorbed-dose distributions was found near front and rear interfaces, absorbed dose being ~ 10 percent higher in front for polystyrene, and ~ 15 and ~ 30 percent lower for copper and lead, respectively. Comparisons of relative experimental values of average absorbed dose for different dosimeter thicknesses with values computed according to Burlin's scheme (which does not consider front-rear asymmetries) were not conclusive for polystyrene and lead, since the assumptions regarding the electron spectrum at the dosimeter site proved to be critical for polystyrene, and the assumptions regarding the photon spectrum critical for lead. For copper, there was agreement to within the limits of experimental reproducibility.

13444. Reed, R. P., Schramm, R. E., Clark, A. F., **Mechanical, thermal, and electrical properties of selected polymers,** *Cryogenics* **13,** No. 2, 67-82 (Feb. 1973).

Key words: Compilation; electrical properties; mechanical properties; plastics; polymers; thermal properties.

An extensive compilation has been completed on the mechanical, thermal, and electrical properties of six commercially available polymers. These data are discussed and summarized here as a function of temperature, radiation, and frequency. A brief description and characterization of each polymer is included.

13445. Ku, H. H., Varner, R., Kullback, S., **Analysis of multidimensional contingency tables,** *Proc. 14th Conf. on the Design of Experiments in Army Research Development and Testing, Edgewood Arsenal, Md., Oct. 23-25, 1968,* ARO-D Report 69-2, pp. 141-180 (1969).

Key words: Contingency tables; estimation of cell frequencies from marginals; generalized independence; hypothesis testing; information theory; interaction; higher-order interaction; computer programs.

This is an expository paper on the analysis of contingency tables given at the Fourteenth Conference on the Design of Experiments. The principle of minimum discrimination information estimation is described and used to generate estimates for tests of hypotheses concerning second-order and higher-order interactions. All classical hypotheses for contingency tables can be generated by the use of this principle when certain marginals are considered as fixed.

Examples are given and two available computation programs are described in detail.

13446. Ledbetter, H. M., **Estimation of Debye temperatures by averaging elastic coefficients,** *J. Appl. Phys.* **44,** No. 4, 1451-1454 (Apr. 1973).

Key words: Debye temperature; elastic constants of solids; elasticity.

Elastic Debye temperatures $\theta$ were calculated by averaging elastic stiffness coefficients. For cubic symmetry, eight averaging methods were evaluated with respect to a computationally exact $\theta$. Reuss's $\theta$, corresponding to uniform stress, gave better agreement than Voight's $\theta$, corresponding to uniform strain. Hill's geometrical $\theta$ gave the best agreement.

13447. Grundl, J. A., **Measurement of the average fission cross-section ratio, $\sigma_f(^{235}U)/\sigma_f(^{238}U)$ for $^{235}U$ and $^{239}Pu$ fission neutrons,** (Proc. Specialists's Meeting on Prompt Fission Neutron Spectra, Vienna, Austria, Aug. 1971), Paper in *Prompt Fission Neutron Spectra,* pp. 107-111 (International Atomic Energy Agency, Vienna, Austria, 1972).

Key words: Fission cross sections; fission neutrons; integral measurements.

Average fission cross-section ratios, $\sigma_f(^{235}U)/\sigma_f(^{238}U)$, have been measured for $^{235}U$ and $^{239}Pu$ fission neutrons. A cavity fission source, a fission ionization chamber, and a redundant determination of fission foil weight ratios were employed for the measurements. The result for $^{235}U$ fission neutrons is $3.71 \pm 0.17$, a value that confirms earlier integral microscopic results and is 12 to 20% discrepant with predictions based on differential microscopic data. The observed ratio of average cross-section ratios, $\chi_{49}/\chi_{25}$, is $0.970 \pm 0.012$. This value represents a departure from unity that is less than one-half of that predicted by differential microscopic data. The measurements described remain in progress.

13448. Drummond, D., Gallagher, A., **A low resolution scanning multiple Fabry-Perot spectrometer,** *Rev. Sci. Instrum.* **44,** No. 4, 396-399 (Apr. 1973).

Key words: Fabry-Perot; spectrometer.

A low resolution scanning multiple Fabry-Perot spectrometer has been built for the observation of very weak extended light sources. The instrument consists of three sets of 7.6 cm diam Fabry-Perot plates operated in central order; their spacings are in a 3-4-5 ratio and are servo controlled using reference light provided by a single master grating monochromator. The instrument is scanned by varying the wavelength setting on the grating instrument. The resolution of the instrument is variable through the range 0.5-15 A, and its luminosity is equal to that of a 5 cm interference filter with a 65% peak transmittance. The free spectral range is about 125 times the peak half-width. Wavelengths in that range are transmitted at a level of $10^{-4}$ or less of the central transmission peak.

13449. Danos, M., **Baryon resonances in nuclei,** *J. Phys.* **33,** Supplement to No. 8-9, 171-182 (Aug.-Sept. 1972).

Key words: Baryons; duality; exchange currents; magnetic moments; mesons; nuclear structure.

The problems one encounters when incorporating baryon resonances and mesons into the nuclear wave function are discussed. Since no workable strong interaction theory exists they must be attacked in a quasi-theoretical step-by-step manner. The present status in the understanding is discussed and the possible future development suggested.

13450. Richmond, J. C., Walters, E. L., **Development of a standard for passive night vision devices, a progress report,** (Proc. Carnahan Conf. on Electronic Crime Countermeasures, Lexington, Ky., Apr. 25-27, 1973), Paper in *Proceedings 1973 Carnahan Conference on Electronic Crime Countermeasures,* UKY Bull. 102, 145-156 (Apr. 1973).

Key words: Contrast transfer function; distortion; flare; image intensifiers; law enforcement; light equivalent background; light induced background; night vision devices; optical gain.

The National Bureau of Standards is developing a standard for night vision devices for use by law enforcement agencies. This work is sponsored by the Law Enforcement Standards Laboratory of NBS, which is financed by the National Institute of Law Enforcement and Criminal Justice of the Department of Justice.

The paper discusses image quality criteria in general, and gives reasons for selecting contrast transfer function (CTF) and distortion as the primary criteria for image quality of night vision devices. The test equipment and procedures used at NBS for testing night vision devices will be described. Specific tests to be included are optical gain, light equivalent background, and flare in addition to contrast transfer function and distortion.

**13451.** Stein, P. G., Boyle, D. R., **How to cope with nickel and diming in your minicomputer,** (Proc. IEEE Minicomputer Conf. on Trends and Applications, National Bureau of Standards, Gaithersburg, Md., Apr. 4, 1973), *Symposium Record,* IEEE Catalog No. 73CHO 760-9 C, pp. 5-7 (1973).

Key words: Computer, computer hardware; computer software; cross-assembler; cross-compiler; hardware; language; minicomputer; software.

Cost centers in minicomputer use are many, and some of them are not obvious to the fledgling user. Most newcomers to the field concentrate on specifying machines for lowest system hardware cost, and sometimes just for lower CPU cost. When the books are balanced at the end of the project, it is always clear that these factors played a small role in the total expense. Recurring maintenance, software development, software maintenance, system changes after installation, and even costs of expendable supplies can all "nickel and dime" you to distraction or even to bankruptcy.

As usual, a careful systems approach, coupled with a realistic understanding of what it *really* costs to develop and operate a minicomputer system, can save a small project from the poorhouse.

**13452.** Davis, R. M., **Automation technology for the retail industry (welcome address),** *Proc. Conf. Automation Technology for the Retail Industry, held at the National Bureau of Standards, Gaithersburg, Md., Mar. 15, 1972,* COM 72-10495, pp. 1-7 (National Technical Information Service, Springfield, Va., 1972).

Key words: Automated customer identification; automated merchandise identification; automatic reading technology; automation technology for retail industry; computers; National Retail Merchants Association; retail industry; retail merchandising; voluntary standards.

This report is made up of the papers presented at the March 15, 1972 conference on Automation Technology for the Retail Industry which was cosponsored by the National Bureau of Standards and the National Retail Merchants Association. The purpose of the conference was to describe the retail industry's automation technology objectives and voluntary standards plans to the manufacturers and suppliers of computer and automatic reading devices. The papers present a frame of reference and summary of the NRMA efforts to apply computer and automated reading technologies to retail merchandising; the retail industry's automation problems; the functional requirements for automated merchandise identification; the NRMA objectives for voluntary industry standards relative to automated merchandise and credit customer identification; and recommended administrative procedures for industry liaison with the NRMA.

**13453.** Cotton, I. W., **A position paper—panel session on intelligent terminals—chairman's introduction,** (Proc. 1973 National Computer Conference and Exposition, New York, N.Y., June 4-8, 1973), Paper in *AFIPS Conference Proceedings* **42,** 217-218 (AFIPS Press, Montvale, N.J., 1973).

Key words: Computer terminals; intelligent terminals.

This article is a description of a forthcoming panel session on Intelligent Terminals which the author will chair at the 1973 National Computer Conference. The theme of the session is explained and the paper authors and panelists are identified.

**13454.** Stabler, T. M., **U.S. membership in the International Organization of Legal Metrology,** *NBSIR 73-159,* 12 pages (Apr. 1973). (Available as COM 73-11174 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Developing countries; International Bureau (BIML); International Committee (CIML); International Conference; International Organization of Legal Metrology; International Recommendations; legal metrology; OIML.

The International Organization of Legal Metrology (OIML) was formed in 1955 to promote intergovernmental cooperation in the field of weights and measures. In addition to its responsibilities as the center of documentation and information exchange in legal metrology, the OIML recommends uniform international requirements for measuring instruments and drafts model laws and regulations for consideration by the member states.

In October 1972 the United States became the 38th member nation of OIML, with NBS being assigned general responsibility for the development of U.S. positions for technical matters arising in the organization.

The benefits to the U.S. of participation in OIML are: (1) To improve opportunities for exporting measuring instruments, (2) To obtain better information regarding measurement techniques in the field, (3) To influence internationally adopted measurement technique so U.S. procedures will not be at a disadvantage, (4) To insure that the U.S. can influence the adoption by developing countries of model laws and uniform procedures, (5) To facilitate the development of an international standards program for the U.S. in legal metrology.

The U.S. Delegation participated in the International Conference of OIML held in London, October 23-28, 1972.

**13455.** Quindry, T. L., **Acoustical evaluation of a single family attached wood-frame modular housing system constructed on an Operation BREAKTHROUGH prototype site,** *NBSIR 73-191,* 21 pages (Apr. 1973). (Available as PB 221695 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Acoustics; field impact insulation class; noise criterion curve; noise isolation class; Operation BREAKTHROUGH.

The acoustical performance of a single family attached wood-frame modular housing system was tested on an Operation BREAKTHROUGH prototype site.

Test results are given concerning the noise isolation of intradwelling walls and floor-ceilings, as well as the noise levels within living units.

**13456.** Costrell, L., Editor, **CAMAC—A modular instrumentation system for data handling,** (AEC Committee on Nuclear Instrument Modules), *AEC Report No. TID-25875,* 66 pages (U.S. Atomic Energy Commission, Washington, D.C., July 1972).

Key words: CAMAC; computer interfacing; control systems; instrumentation; instrumentation standards; nuclear instrumentation; standards.

CAMAC is a digital data handling system in widespread use with on-line digital processors and computers. The system is based on a digital highway for data and control. Mechanical and signal standards are specified to ensure physical and operational compatibility between units from different sources. Except for pages i-vi, 46A and 46B, this report is identical to EURATOM Report EUR 4100e dated 1972. AEC Report TID-25877 constitutes a supplement to and is to be used in conjunction with this report. This revised specification introduces several new features but is consistent with the previous version (EUR 4100e, 1969).

The CAMAC system was specified by European laboratories through the ESONE Committee and has been endorsed by the U.S. AEC NIM Committee.

**13457.** Costrell, L., Editor, **Supplementary information on CAMAC instrumentation system,** (AEC Committee on Nuclear Instrument Modules), *AEC Report No. TID-25877,* 45 pages (U.S. Atomic Energy Commission, Washington, D.C., Dec. 1972).

Key words: CAMAC; computer interfacing; control systems; instrumentation; instrumentation standards; nuclear instrumentation; standards.

This report contains supplementary information to be used in conjunction with AEC Report TID-25875 (EUR 4100e, 1972), which describes the CAMAC modular instrumentation system for data handling, and AEC Report TID-25876 (EUR 4600e, 1972) which defines a CAMAC branch highway and crate controller. Included are recommendations concerning the implementation and interpretation of the specifications and descriptions of preferred practices and current applications. This report does not modify the specifications referred to above.

**13458.** Schroder, I. G., **Emission of long-range $\alpha$-particles in the subthermal-, thermal- and resonance-neutron fission of $^{239}$Pu,** *Nucl. Phys.* **A195,** 257-268 (1972).

Key words: Alpha-particle; emission; fission; neutron; reactor; $^{239}$Pu.

An investigation has been made of the possible dependence of the binary-to-ternary fission ratio as well as of the energy distribution of the long-range $\alpha$-particles emitted in the low-energy fission of $^{239}$Pu on the energy of the incident neutron. To this effect a number of relative measurements have been made using three neutron filters covering, respectively, the subthermal-, thermal- and resonance-neutron regions. Furthermore, a measurement of the binary-to-ternary fission ratio has been performed for a reactor beam. The results obtained show no variation in the binary-to-ternary fission ratio or in the energy of the long-range $\alpha$-particles for the energy intervals considered to within the precision of these measurements. The measurement with the reactor beam yielded a value of the binary-to-ternary fission ratio of $412 \pm 11$.

**13459.** Franzen, D. L., **Continuous laser-sustained plasmas,** *J. Appl. Phys.* **44,** No. 4, 1727-1732 (Apr. 1973).

Key words: Gas breakdown; laser; plasma.

Continuous plasmas sustained by a focused high-power $CO_2$ laser are described. The power required for maintaining a cw plasma following preionization has been determined for Xe, Kr, and Ar, and attempted for Ne and He. Measurements indicate the noble gases with the lowest ionization potentials have the lowest sustaining thresholds. Radiative properties of some of the plasmas were studied with calorimetric techniques. Under certain conditions, more than half of the incident laser radiation can either be scattered or absorbed by the plasma. A major loss mechanism for the plasma is shown to be radiation in the visible and ultraviolet. Spectra of low-pressure Xe plasmas indicate the presence of ultraviolet transitions with a high contrast over the continuum.

**13460.** Le Neindre, B., Tufeu, R., Bury, P., Sengers, J. V., **Thermal conductivity of carbon dioxide and steam in the supercritical region,** *Ber. Bunsenges. Physik. Chem.* **77,** No. 4, 262-275 (1973).

Key words: Carbon dioxide; critical phenomena; steam; thermal conductivity; transport properties.

The thermal conductivity of carbon dioxide and steam has been measured as a function of temperature and density using a concentric cylinder method. Earlier measurements of the thermal conductivity of $CO_2$, obtained with a parallel plate method, covered a range of temperatures from 25 to 75 °C and revealed the existence of an anomalous thermal conductivity in the critical region. In this paper the experimental temperature range for the thermal conductivity of $CO_2$ is extended to 700 °C. The high temperature data enable us to determine a "background" thermal conductivity needed for a quantitative analysis of the anomalous thermal conductivity in the critical region. In addition, we provide experimental evidence that the thermal conductivity of steam exhibits an anomalous increase in the critical region similar to the behavior observed for the thermal conductivity of $CO_2$.

**13461.** Armstrong, G. T., **Calorimetric reference materials—status of the primary standard,** *Proc. 1st Int. Conf. on Calorimetry and Thermodynamics, Warsaw, Poland, Aug. 31-Sept. 4, 1969,* pp. 261-267 (Polish Scientific Publishers, Warsaw, Poland, 1971).

Key words: Benzoic acid; calorimetric reference materials.

Reference materials for reaction calorimetry are briefly reviewed. The value of 26434 $Jg^{-1}$ for the energy of combustion of the primary standard, benzoic acid, has been confirmed by three recent careful determinations, and give this value a very sound basis. Any future investigations leading to a possible change in this value will require extremely careful documentation of precision and accuracy of measurement. Possible sources of systematic error are discussed.

**13462.** Hessel, M. M., Lucatorto, T. B., **The rotating heat-pipe oven; a universal device for the containment of atomic and molecular vapors,** *Rev. Sci. Instrum.* **44,** No. 5, 561-563 (May 1973).

Key words: Heat pipe; indium iodide; laser application; sodium; spectroscopic application.

A new type of heat-pipe oven has been developed that uses centrifugal force as a return mechanism for the condensed vapors in contrast to capillary return forces for the conventional heat-pipe oven. Since this new oven is no longer limited to materials that wet wicks, it can be used to contain *any* material that does not react with the walls of the containing vessel. We describe the operation of this oven with sodium and InI even when the InI is solid. Spectroscopic and laser applications of the "rotating" heat-pipe oven are discussed.

**13463.** Lozier, D. W., Maximon, L. C., Sadowski, W. L., **A bit comparison program for algorithm testing,** *Comput. J.* **16,** No. 2, 111-117 (May 1973).

Key words: Algorithm testing; bit comparison testing; computer algorithm; mathematical function subroutines.

In view of the increasingly important role of the computer in scientific calculations, the development of computer algorithms for elementary and special functions has been given a great deal of attention. The development of algorithms cannot be divorced from their evaluation, for a computer algorithm is judged solely on the basis of its performance characteristics. These include storage requirements, speed and accuracy. The present paper will deal only with the accuracy aspect of algorithm testing. The other two aspects must be evaluated in the context in which the algorithm is used. In this paper by an algorithm we mean a computer algorithm, i.e., an implementation of a mathematical algorithm in a specific environment. The environment is taken to include factors that may affect the algorithm, e.g., the operating system under which the program is run and hardware algorithms for arithmetic operations. Whereas in some instances mathematical algorithms have been successfully used to locate hardware malfunctions that were not traceable by normal trouble shooting

tests, any malfunctions of the software or hardware will not be considered here to be part of the environment.

**13464.** Rosenstock, H. M., Larkins, J. T., Walker, J. A., **Interpretation of photoionization thresholds: Quasiequilibrium theory and the fragmentation of benzene,** *Int. J. Mass Spectrom. Ion Phys.* **11,** 309-328 (1973).

Key words: Appearance potential; benzene; photoionization; quasiequilibrium theory.

Quasiequilibrium theory has been applied to the parent ion fragmentation of benzene. Assuming uniform excitation energy transfer in the fragmentation threshold region and applicability of the step-function photoionization threshold law, it is possible to calculate fragment photoionization threshold curves in good agreement with experiment. It is concluded that the unimolecular decomposition occurs via two independent pairs of competing reactions. One pair of reactions leads to the formation of $C_6H_5^+$ and $C_6H_4^+$, and involves the benzene ion ground state. The other pair of reactions, leading to $C_4H_4^+$ and $C_3H_3^+$ involves the first excited state of $C_6H_6^+$ lying 2.25 eV above the ground state, or an open chain isomer having a similar heat of formation. At threshold the $C_6H_5^+$ ion has a phenyl ion structure, the $C_3H_3^+$ ion a cyclopropenyl ion structure and the $C_4H_4^+$ ion may have a cyclobutene ion structure. A heat of formation of ~ 100 kcal/mol is derived for the benzyne molecule, in good agreement with semi-empirical estimates. Kinetic shift effects on the fragmentation thresholds are found to be important. Some difficulties are encountered in the comparison of relative abundances of parent ion metastable transitions to the relative abundances of the daughter ions near threshold. The calculated energy dependence of the unimolecular rate of formation of $C_4H_4^+$ ion is in good agreement with experiment. However, the weak energy dependence of the rate of formation of $C_6H_5^+$ found experimentally cannot be explained. Suggestions for further work are outlined.

**13465.** Zimmerman, J. E., Siegwarth, J. D., **Portable helium dewars for use with superconducting magnetometers,** *Cryogenics* **13,** No. 3, 158-159 (Mar. 1973).

Key words: Dewar; gas shielded; helium; liquid; magnetometer; multilayer insulated.

Simple helium dewars have been constructed using gas-cooled radiation shields and multilayer aluminized plastic insulation. They will retain one litre of liquid for up to 40 hours. The shields may be made mostly non-conducting so the dewar can be used with ultrasensitive superconducting magnetometers. For most other applications thin sheet metal such as copper or aluminium is suitable for the shields.

**13466.** Roszman, L. J., Hooper, C. F., Jr., **Distribution of the time-dependent microfield in a plasma,** *Phys. Rev. A* **7,** No. 6, 2121-2130 (June 1973).

Key words: Distribution; Holtsmark; ion dynamics; microfield; plasma; time-average.

The theory of the distribution of the time average of the time-dependent microfield in a quantum plasma taken over a finite time interval is introduced and developed. The short- and long-time limits are derived. The Wigner phase-space representation is employed to derive the correct distribution for a classical plasma and to establish a formalism which can be used for low-order quantum corrections. Numerical results are presented for a classical gas of charged noninteracting particles. It is found that for time-averaging intervals, which are larger than the time it takes a particle traveling with the average thermal velocity to cross the ion-sphere radius, the distribution deviates from the corresponding Holtsmark distribution for the quasistatic model.

**13467.** Edelsack, E. A., Kropschot, R. H., Olien, N. A., Olsen, J. L., **A Directory of European Low Temperature Research,** *Cryogenics* **13,** No. 3, 132-133 (Mar. 1973).

Key words: Cryogenics; European low temperature research.

The publication of a Directory of Low Temperature Research in seventeen European countries is described. The Directory contains the names of some three hundred researchers, their addresses, telephone numbers, and brief descriptions of their research interests. Information for obtaining free copies of the Directory is included.

**13468.** Linsky, J. L., **A recalibration of the quiet sun millimeter spectrum based on the moon as an absolute radiometric standard,** *Solar Phys.* **28,** No. 2, 409-418 (Feb. 1973).

Key words: Millimeter absolute radiometry; millimeter solar continuum; solar chromosphere.

The solar millimeter continuum between 1 and 20 mm is recalibrated using observations of the average lunar brightness temperature at the center of lunar disk and new Moon brightness temperatures. The solar data are placed on a common scale according to the average lunar brightness temperature distribution proposed by Linsky. A least-squares parabolic regression curve is proposed for the solar millimeter continuum. A small departure from this regression curve near 8 mm may indicate the existence of an absorption feature.

**13469.** Cezairliyan, A., **A high-speed (millisecond) system for studies of phase transitions and thermophysical properties of electrical conductors above 2000 K,** *Proc. Int. Conf. on Etude des Transformations Cristallines a Haute Température, Odeillo, France, Sept. 27-30, 1971,* No. 205, 25-32 (Centre National de la Recherche Scientifique, Paris, France, 1972).

Key words: High-speed methods; high temperature; phase transitions; refractory metals; thermophysical properties.

A high-speed system is described for conducting studies on phase transitions, and for measuring selected thermophysical properties of electrical conductors at temperatures above 2000 K. The system can measure specific heat electrical resistivity, hemispherical total emittance, and melting point in subsecond duration experiments. Temperature measurements are made with a millisecond resolution photoelectric pyrometer. Experimental quantities are recorded with a high-speed digital data acquisition system. The entire system has a time resolution of approximately 0.4 millisecond. An experiment simulating the conditions of phase transitions is described. Results of measurements on solid-liquid phase transitions in niobium, molybdenum, and tungsten are presented. High-speed measurements of selected thermophysical properties of niobium, molybdenum, tantalum, and tungsten are summarized. Sources and magnitudes of errors are discussed.

**13470.** Straty, G. C., Younglove, B. A., **Velocity of sound in saturated and compressed fluid oxygen,** *J. Chem. Thermodyn.* **5,** No. 3, 305-312 (May 1973).

Key words: Compressed liquid; compressibility; saturated liquid; sound velocity oxygen; specific heat ratio.

In a continuing effort to generate accurate thermodynamic and transport properties of cryogenic fluids, we have measured the velocity of sound in saturated liquid oxygen from 58 to 150 K and in compressed fluid oxygen along isotherms from 70 to 300 K at pressures to 34 MPa. The results have been used along with previously measured $p, \rho, T$ results to obtain the isentropic compressibility and the heat capacity ratio, and to examine the quali-

ty of the $p$, $\rho$, $T$ data by comparison of the measured velocities with velocities calculated from these data.

**13471.** Molino, J., **Perceiving the range of a sound source when the direction is known,** *J. Acoust. Soc. Amer.* **53,** No. 5, 1301-1304 (May 1973).

Key words: Audition and ranging; physiological and psychological acoustics; psychophysics; space perception.

A modification is proposed in Hirsch's equation for determining the range of a sound source of unknown strength [H. R. Hirsch, J. Acoust. Soc. Am. **43,** 373-374 (1968)]. The modified formula applies to the case where the direction of the sound source is known. Greene's comments on Hirsch's letter are investigated for their ability to predict the limitations on the resolution obtainable in human auditory ranging [D. C. Greene, J. Acoust. Soc. Am. **44,** 634 (1968)]. In a brief experiment, two subjects were unable to make distance judgments for sustained pure-tone sources over ranges of 3 to 48 ft.

**13472.** Lew, H. S., **The effect of impact loadings on the performance of wood joist subflooring systems,** *NBSIR 73-187,* 49 pages (May 1973). (Available as PB 221188 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Concentrated loads; deflection; floor hardboard; housing; impact energy; Operation BREAKTHROUGH; plywood; subfloors; underlayment; wood; wood joists.

This report presents the results of an experimental study of wood-joist subflooring systems subjected to impact load. Six different types of subflooring systems were tested following the test method described in the ASTM Standard Methods (ASTM Designation E-72). The magnitude of impact load was varied by dropping a 60-lb bag from different heights.

A concentrated static load of 400 lb was applied to the subfloor after it was exposed to impact load. It is suggested that the deflection under this concentrated load be used as a measure of the impact resistance of the subfloor.

**13473.** Reichard, T. W., Greene, W. E., Jr., Cattaneo, L. E., Masters, L. W., **Structural tests on housing components of glass fiber reinforced polyester laminate,** *NBSIR 73-188,* 98 pages (Apr. 1973). (Available as PB 221183 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Adhesive bond; aging; composites; compression; flexure; glass fiber; housing system; innovations; laminate; Operation BREAKTHROUGH; racking; reinforced plastics; reinforced polyester; sustained loading; tensile shear.

This report describes a series of structural evaluation tests performed on housing components made with a glass fiber reinforced polyester (FRP) laminate. The components tested were: (1) the FRP laminate used for the facings and the corrugated core of the basic panel; (2) the adhesive bond between the facing and core; (3) typical wall panels; and (4) typical roof panels. Test data include: (1) the effect of temperature and moisture on the tensile and compressive strength of the FRP laminate; (2) the effect of temperature, accelerated aging and sustained loads on the tensile shear strength of the facing-to-core polyester adhesive bond; (3) the short-term strength of the wall panels under compressive and in-plane shear loading; (4) the long-term strength of the wall panels under sustained compressive loading; and (5) the short-term and long-term performance of the roof panels under flexural loading.

**13474.** Churney, K. L., West, E. D., Armstrong, G. T., **A cell model for isoperibol calorimeters,** *NBSIR 73-184,* 100 pages (Apr. 1973). (Available as COM 73-11110 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Calorimetry; energy equivalents; energy measurement; heat transfer; internal energy measurement; isoperibol calorimeters; measurement theory.

A calorimeter can be modeled as a large number of volume elements or cells in each of which the temperature may be considered uniform, and each of which can store heat and exchange heat with other cells. Application of the first law of thermodynamics to this set of cells leads to representations of the usual calorimetric equations for internal energy change expressed in terms of measurable or estimatable heat capacities, heat transfer coefficients, temperatures, and work terms for the individual cells. Analysis of the results yields a framework within which most of the design and measurement problems of isoperibol calorimeters can be treated.

**13475.** Somes, N. F., **Abnormal loading on buildings and progressive collapse,** *NBSIR 73-221,* 76 pages (May 1973). (Available as PB 220849 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Abnormal loading; building; codes; design criteria; multistory; progressive collapse; risk; stability; standards; strength; United States.

The document is an interim report of ongoing studies at the National Bureau of Standards. It defines the several aspects of abnormal loading on buildings and the problem of progressive collapse. It documents the extent to which present U.S. Codes and Standards address the problem.

Abnormal loadings are identified, classified and discussed with regard to their characteristics and frequencies of occurrence. The report reviews the state of international knowledge of the characteristics of abnormal loadings and the response of buildings and building elements to these loadings. The latter includes discussion of several incidents in which multistory buildings have collapsed progressively.

Using currently available statistics an estimate is made of the combined frequency of abnormal loadings on residential buildings in the U.S. For buildings susceptible to progressive collapse, the corresponding risk of fatality is compared with the levels of risk that society will generally accept. The risk is further compared with the risk of mortality associated with fire in residential buildings, an area of considerable public concern and expenditure.

It is concluded that U.S. standards-writing bodies should adopt appropriate rational criteria as soon as possible to reduce the risks of progressive collapse. There are several areas in which criteria might be introduced to reduce the risk of progressive collapse. These are discussed; particular attention is given to the philosophies behind the structural criteria implemented in the USA and other countries.

**13476.** Peiser, H. S., Corruccini, R. J., Newman, S. B., **Standardization and measurement services in Turkey,** *NBSIR 73-172,* 90 pages (Oct. 14-28, 1972). (Available as COM 73-11175 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: AID; assistance; economics; LDC's (less developed countries); measurement services; standardization; survey; Turkey.

The survey of standardization and measurement services for developing industries in Turkey has been carried out by NBS with funding by AID, with participation by representatives of Ecuador and Korea, and under the guidance of the Turkish Standards Institute. The Survey Team spent two weeks in Turkey

where it inspected representative laboratories and plants, and had discussions with leaders of Government, the USAID Mission, principal universities and industry. The Report describes the preparation for the Survey, a summary of the economy of the country soon to be a full member of the European Common Market, notes on Turkish science and technology and the independent Turkish Standards Institute recognized by law as the national standards body. Issues addressed are 1) Standards Development, 2) Test Methodology, 3) Product Certification, 4) Product Testing, 5) Calibration, 6) Weights and Measures Control, 7) Export Control, 8) Quality Control, 9) Consumer Protection, 10) Industrial Extension, 11) Building Codes, 12) International Contacts, and 13) Publications. The principal conclusion is that the Turkish economy would benefit from a strengthening of standardization and measurement services. Appropriate recommendations are offered.

**13477.** Tsai, D. H., MacDonald, R. A., **Second sound in a solid under shock compression,** *J. Phys. C: Solid State Phys. Letter to Editor* **6,** L171-L175 (1973).

Key words: Crystalline solid; iron; molecular dynamics; second sound; shockwave; thermal relaxation; three dimensions.

The propagation of a strong shock wave in a perfect, three-dimensional crystalline lattice is studied by means of molecular-dynamical calculations. The results show that behind the shock front there is a region of thermal relaxation which increases with time. The thermally relaxed region, therefore, propagates with a velocity lower than that of the shock front. It is believed that the wave-like propagation of this thermally equilibrated region is a natural extension of second sound from the conventional low-temperature, low-pressure régime to the high-temperature, high-pressure régime. The implication of this phenomenon on *PVT* calculations from shock-wave data is discussed briefly.

**13478.** Negas, T., **The $SrMnO_{3-x}$-$Mn_3O_4$ system,** *J. Solid State Chem.* **7,** 85-88 (1973).

Key words: Nonstoichiometry; phase equilibria; $SrMnO_{3-x}$-$Mn_3O_4$ system; $SrMn_3O_{6-x}$.

Phase relations were determined in the $SrMnO_{3-x}$-$Mn_3O_4$ system at elevated temperatures in air using quenching, gravimetric, and x-ray diffraction techniques. The system contains one intermediate compound, $SrMn_3O_{6-x}$ ($0 \leq x \leq 0.10$ between 900-1200 °C), which decomposes to $SrMnO_{3-x}$ plus $Mn_3O_4$ near 1215 °C. The existence of an oxygen deficient $SrMnO_{3-x}$ having the hexagonal 4-layer structure was confirmed. Crystals of perovskite-like $SrMnO_{3-x}$ ($x > 0.25$) were grown from its primary field located in the system.

**13479.** Dhez, P., Ederer, D. L., **Photoionization resonance profile parameters of the 3s3p $^1P_1$ two-electron excitation in He I,** *J. phys. B: At. Mol. Phys. Letter to Editor* **6,** L59-L64 (Apr. 1973).

Key words: Autoionization; cross section; Fano parameters; helium; photoionization; resonance profile.

The cross section profile of the 3s3p $^1P_1$ two-electron excitation has been measured in He I. The cross section was assumed to have the form

$$\sigma(E) = C(E) + \frac{(E-E_0)\frac{1}{2}\Gamma a + (\frac{1}{2}\Gamma)^2 b}{(E-E_0)^2 + (\frac{1}{2}\Gamma)^2}$$

where the adjustable parameters $a$, $b$, $1/2\Gamma$ and $E_0$ were determined by a least squares fitting process. The parameter values obtained in the experiment were: $a = 0.86 \pm 0.16$ cm$^{-1}$, $b = 0.27 \pm 0.13$ cm$^{-1}$, $1/2\Gamma = 65.9 \pm 7.0$ meV, $E_0 = 69.919 \pm 0.007$ eV. The Fano parameters $q$ and $\sigma_a$ were determined from $a$ and $b$ and had the values $1.36 \pm 0.20$ and $0.32 \pm 0.08$ cm$^{-1}$ respectively.

**13480.** Hamilton, C. A., **Analog-computer studies of mixing and parametric effects in Josephson junctions,** *J. Appl. Phys.* **44,** No. 5, 2371-2377 (May 1973).

Key words: Analog; Josephson junction; mixing; parametric.

Analog-computer studies are made on a variety of mixing and parametric effects in Josephson junctions. The predictions of the constant-voltage model are compared with the more general behavior of a junction in a resistive circuit. A simple approximate method is developed for calculating frequency conversion efficiency and the matching condition for a junction operating in the oscillator mixer mode. A similar calculation is made for the second mode of operation, in which an external local oscillator is used. In either of these modes, frequency conversion gain is possible even in a purely resistive circuit. The conditions for parametric amplification without frequency conversion are also studied and it is found that gain occurs only when the self-oscillation frequency is near the signal frequency.

**13481.** Smith, R. L., Phelan, R. J., Jr., **Limitations of the use of vacuum photodiodes in instruments for the measurement of laser power and energy,** *Appl. Opt.* **12,** No. 4, 795-798 (Apr. 1973).

Key words: Biplanar vacuum photodiodes; lasers; laser energy measurements; laser power measurements; vacuum photodiodes.

The effect of the variation in the area sensitivity upon the calibration of instruments incorporating biplanar vacuum photodiodes for the measurement of laser power and energy is discussed. A technique for the measurement of the area sensitivity is described, and the experimental results for several tubes are given. At the present time it would appear to be difficult to use biplanar vacuum photodiodes in devices to measure laser energy or power.

**13482.** Eisenhower, E. H., **Safety recommendations in ANSI documents,** (Proc. Symp. on Radiation Safety and Protection in Industrial Applications, Washington, D.C., Aug. 16-18, 1972), *DHEW Pub.* No. (FDA) 73-8012, H. F. Klein, Ed., pp. 240-252 (U.S. Department of Health, Education, and Welfare, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, Rockville, Md., Oct. 1972).

Key words: Radiation safety; radiography; voluntary standards; x rays.

This paper discusses American National Standards relating to safety in industrial applications of ionizing radiation. It includes methods by which voluntary standards are produced, and outlines approval procedures required for designation as an American National Standard. The structure and relevant activities of Standards Committee N43, of the American National Standards Institute (ANSI) are described. Maximum permissible dose equivalent values recommended by the National Council on Radiation Protection and Measurements are presented as the basis for requirements in ANSI standards. Existing and future standards of interest to radiation safety in industrial applications are outlined.

**13483.** Powell, C. J., **High-resolution measurements of Auger-electron and photoelectron structure in the secondary-electron energy distributions of aluminum, nickel and copper,** (Proc. Int. Conf. on Inner Shell Ionization Phenomena and Future Applications, Atlanta, Ga., Apr. 17-22, 1972), Paper in *Proceedings of the International Conference on Inner Shell Ionization Phenomena and Future Applications,* R. W. Fink, S. T. Man-

son, J. M. Palms and P. V. Rao, Eds., CONF-720404, 1, 743-756 (U.S. Atomic Energy Commission, Technical Information Center, Oak Ridge, Tenn., Jan. 1973).

Key words: Aluminum; Auger-transitions; copper; electronic density of states; nickel; photoelectron energy distribution; secondary-electron energy distribution; x-ray photoemission.

Measurements are reported of selected structure in the secondary electron energy distributions of evaporated aluminum, nickel and copper. The specimens were bombarded with 3 keV electrons and the secondary structure was measured with a resolution of 0.1 eV. For each metal, attention was given primarily to data that could give information on the valence-band density of states.

Attempts were made to observe the $AlKL_{2,3}M$ Auger-electron energy distribution expected at about 1470 eV. Structure was, however, observed with a high-energy edge of $1485.9 \pm 0.5$ eV and a breadth of 8-9 eV. This structure was interpreted as being due to photoemission of valence electrons by internally generated $K\alpha$ x-rays and was similar to uv photoelectron distributions and to the calculated density of states. Inelastic scattering of the photoelectrons obscures the expected $AlKL_{2,3}M$ structure.

Auger electron peaks in the ranges 730-800 eV and 820 to 865 eV were measured in the energy spectra for nickel and copper, respectively. Structure was observed in the $L_3M_{2,3}M_{4,5}$ transition which could be associated in part with solid-state effects and in part with the final atomic states of each element. Density-of-states data could not be derived from the Auger spectra without more detailed knowledge of the final states expected after the Auger transition of interest.

**13484.** Garvin, D., **Progress in rate evaluations,** (Proc. 7th Thermochemistry Working Group, Interagency Chemical Rocket Propulsion Group, Cleveland, Ohio, Apr. 9-11, 1969), *CPIA Pub. 189*, I, 109-118 (Chemical Propulsion Information Agency, Johns Hopkins University, Applied Physics Laboratory, Silver Spring, Md., Aug. 1969).

Key words: Art of evaluation; chemical reactions; quality control measures; rate constants; rate evaluations.

A survey is given of recent activities in the area of evaluation of rates of chemical reactions. The problem of quality control is discussed. A recent evaluation of rates of reactions of oxygen is used to illustrate the uses of evaluated data and conclusions that can be drawn from them. A plan for expanding evaluation efforts is offered.

**13485.** Soulen, R. J., Jr., Schooley, J. F., **Superconducting transition widths and reproducibilities,** (Proc. XIIIth Int. Congress of Refrigeration, Washington, D.C., Aug. 27-Sept. 3, 1971), Paper in *Progress in Refrigeration Science and Technology* 1, 399-403 (Avi Publ. Co., Inc., Westport, Conn., 1973).

Key words: Superconductivity; thermometry, transition temperature.

As part of a program to investigate the possibility of utilizing superconductive transitions as reference points on a cryogenic temperature scale, we are examining the transitions of samples with different purities and with various metallurgical histories. In our initial efforts, we examined the transition widths of Pb, Sn, In, Al, Ga, Zn and Cd wires using short mutual inductance coils to avoid end effects. As we reported at the XII Int. Conf. on Low Temperature Physics, all but the Sn and Cd samples showed transition widths of $10^{-3}$ K or less, and repeated examination of the widths over an extended period of temperature cycling showed no drift or broadening of the five narrow transitions larger than $10^{-3}$ K.

We are now preparing samples of Pb, In, Al, Zn and Cd with various impurities and with various forming and annealing procedures in order to determine the practical boundary conditions for obtaining a given transition temperature and transition width. We are attempting to extend this study to low temperature (Ir, $T_c \approx 0.1$ K) and high-temperature ($Nb_3X$, $V_3Si$, $T_c = 15 - 20$ K) materials, although intitial experiments show transition widths of $0.1 - 0.3$ K for the latter.

**13486.** Roth, R. S., Parker, H. S., Brower, W. S., Waring, J. L., **Phase equilibria, crystal chemistry and crystal growth of alkali oxide-metal oxide systems,** (Proc. NATO sponsored Advanced Study Institute, Belgirate, Italy, Sept. 1972), Paper in *Fast Ion Transport in Solids,* pp. 217-232 (North-Holland Publ. Co., Amsterdam, The Netherlands, 1973).

Key words: Alkali oxides; crystal chemistry; crystal growth; phase equilibria; system $LiTaO_3$-$Ta_2O_5$; system $NaTaO_3$-$Ta_2O_5$; system $KTaO_3$-$Ta_2O_5$.

In view of the recently discovered properties of the sodium ion in $\beta$-alumina, it is of some scientific and practical importance to review the chemistry of alkali ions in oxide systems in general. From a practical point of view, however, the number of systems of interest will necessarily be severely limited. For commercial utilization of ionic conductivity it is necessary to limit systems to those which will contain little or no electronic conductivity and therefore do not contain an element which is easily reduced during the synthesis. For fast ion transport it is probably advantageous to have an alkalai ion in a "non-stoichiometric" crystallographic position. Attention will be concentrated on methods of study of alkali oxide-tantalum oxide systems as applied to the search for new crystallographic phases which may be of interest.

New results are presented of phase equilibria studies in the systems $Li_2O$, $Na_2O$ and $K_2O$ with $Ta_2O_5$ and $Li_2O$ with $Nb_2O_5$. In addition preliminary results will be discussed of the ternary systems involving the binaries with $MoO_3$. These ternary systems have been utilized for flux-growth of single crystals of many of the new phases in the binary systems. Each of the $Ta_2O_5$ systems has at least one interesting non-stoichiometric phase which deserves further study for conductivity properties. A phase in the $Li_2O$-$Ta_2O_5$ system has the structure of the low-temperature form of $Ta_2O_5$, the $Na_2O$-$Ta_2O_5$ system contains a phase with a "tetragonal-bronze"-like structure and the $K_2O$-$Ta_2O_5$ system has both "tetragonal-" and "hexagonal-bronze"-like phases. In the sub-system $Ta_2O_5$-$KTaO_3$ eleven distinct phases have been found where only two were previously known.

**13487.** Pike, R. G., Hay, R. E., Clifton, J. R., Beeghly, H. F., Mathey, R. G., **Nonmetallic coatings for concrete reinforcing bars,** *Public Roads* **37,** No. 5, 185-197 (June 1973).

Key words: Chlorides; concrete; corrosion; epoxy coatings; organic coating; steel reinforcing bars.

The study reported here was conducted to determine the feasibility of using organic coatings, especially epoxies, to protect steel reinforcing bars embedded in concrete from corrosion accelerated by chloride ions.

Coatings were evaluated on the basis of their chemical and physical durabilities as well as their protective qualities. In this study, attention was also directed to the application methods and surface preparation of the steel reinforcing bars. Four different materials appear to be suitable for such coatings.

**13488.** Barnes, J. D., **Neutron inelastic scattering study of the "rotator" phase transition in n-alkanes,** (Proc. 5th Symp. on

Neutron Inelastic Scattering, Grenoble, France, Mar. 6-10, 1972), Chapter in *Neutron Inelastic Scattering*, pp. 287-299 (International Atomic Energy Agency, Vienna, Austria, 1972).

Key words: n-Alkanes; n-nonadecane; neutron inelastic scattering; phase transition; rotational diffusion; rotator phase.

Many n-alkanes exhibit a solid-solid phase transition a few degrees below their melting points. Such characteristics of the phase transition as transition temperatures, volume change on transition, and heats of transition are very sensitive to chain length in these materials. To characterize the role which molecular motions play in this phase transition, inelastic neutron scattering experiments were carried out on the Fermi chopper time-of-flight spectrometer at the National Bureau of Standards Reactor. Experiments were performed on n-nonadecane at temperatures of 77, 291, 297, 301 and 307 K and on n-eicosane at 301 K. Momentum transfers ranged between .42$Å^{-1}$ and 3.3 $Å^{-1}$ for 2.467 Å neutrons. The full width at half maximum of elastically scattered neutrons was found to be 1.58 $ps^{-1}$ from measurements of scattering from vanadium ($\Delta\lambda/\lambda = 4.6\%$). 297 K and 301 K are above the temperature of the "rotator" phase transition for n-nonadecane. The spectra taken under these conditions consist of a broadened elastic peak superimposed on a continuous spectrum arising from the vibrational modes of the system. The broadening of the elastic peak is found to depend on momentum transfer and is analysed in terms of models involving rotational diffusion of the molecule about the long axis of the chain. The data at 307 K, where the material is molten, reveal a further increase in the quasi-elastic component of the scattering.

**13489.** Kruger, J., **Application of ellipsometry to electrochemistry,** Chapter in *Advances in Electrochemistry and Electrochemical Engineering*, R. H. Muller, Ed., **9**, 227-280 (John Wiley & Sons, Inc., New York, N.Y. 1973).

Key words: Corrosion; electrochemistry; electropolishing; ellipsometry; electrodeposition.

A review of the application of ellipsometry to electrochemistry is given which considers the electrochemical phenomena of passivation and corrosion, electroadsorption, electrodeposition and electropolishing. The ellipsometry of bare surfaces and gaseous adsorption as related to electrochemistry is discussed. Both the advantages and limitations of the techniques are considered. Over a hundred references are cited.

**13490.** Maienthal, E. J., **Determination of trace elements in metals by differential cathode ray polarography,** *Amer. Lab.*, pp. 25-33 (1972).

Key words: Alloys; analyses; cast irons; differential cathode ray polarography; high purity materials; metals; steels; trace elements.

Some of the recent applications of cathode ray polarography at NBS to the determination of a number of trace elements in different metal matrices will be discussed. Some of the elements could be determined directly with no separations. The elements determined included aluminum, antimony, copper, cadmium, iron, lead, bismuth, and tellurium in matrices such as steels, high temperature alloys, white cast irons, brasses, bronzes, and high purity metals. The results will be compared with those obtained by other techniques.

**13491.** Garvin, D., Hampson, R. F., **Evaluated rate and photochemical data for modeling of the stratosphere,** (Proc. 2d Conf. on Climatic Impact Assessment Program, Cambridge, Mass., Nov. 14-17, 1972), *DOT Report* No. TSC-OST-73-4, 12 pages (Transportation Systems Center, Department of Transportation, Cambridge, Mass., 1972).

Key words: Atmospheric chemistry; chemical kinetics; data evaluation; nitrogen oxides; ozone; photochemistry; stratosphere; water.

Three important types of input data for studies of the chemistry of the stratosphere are rate constants, absorption coefficients, and quantum yields for elementary processes. About 135 of these data items are needed for studies that will define the chemistry of the stratosphere. These data are being obtained both by experiment and by review and evaluation of existing measurements.

The data-evaluation program has two parts: evaluation by a group at NBS, and a cooperative survey by a large number of gas kineticists. The evaluated data now available are summarized in a table. The possible interactions among 42 species that may be present in the stratosphere are displayed on a reaction grid. Where possible the importance of a reaction and the status of its data are indicated.

Pollutants introduced into the stratosphere will interact with the existing complex $O_3/O_2/NO_x/HO_x$ photolytic system. Laboratory studies of the $O_3/O_2$ and $O_3/H_2O_2$ photolytic systems and rate measurements in an $O/O_3/NO_x$ system illustrate the types and magnitudes of effects to be expected.

**13492.** Slattery, W. J., **Standards information for your company,** *Stand. Eng.* **25**, No. 3, p. 22, (June 1973).

Key words: Company; information; standardization; standards.

The Standards Information Services Section of the National Bureau of Standards (NBS-SIS) maintains the largest reference collection of engineering and related standards, specifications, test methods, codes and recommended practices in the United States. From its original holdings of several thousand standards, NBS-SIS now maintains an extensive reference collection of over 122,000 standards issued by U.S. industry associations, federal and state governmental organizations, and foreign national and international standardizing bodies. NBS-SIS serves primarily as a referral activity by identifying sources of standards, and directing inquirers to the respective standards-issuing organizations to obtain copies of standards. By means of a computer-produced Key-Word-In-Context (KWIC) Index, more than 4,000 inquiries are answered a year. Although the majority of these requests have to date come from agencies of the U.S. Federal Government, the staff is particularly interested in receiving an increase in the number of inquiries from the corporate sector. NBS-SIS also compiles computer-produced indexes designed to assist companies and other industry groups, government organizations and anyone interested in information on standards. Requests for information may be made by personal visit, telephone or letter.

**13493.** LaFleur, P. D., **Retention of mercury when freeze-drying biological materials,** *Anal. Chem.* **45**, No. 8, 1534-1536 (July 1973).

Key words: Freeze-drying; lyophilization; mercury; mercury loss; methylmercury; nuclear activation analysis; phenylmercuric acetate.

The retention on freeze-drying of three compounds of mercury tagged with mercury-203 and fed to experimental animals, has been measured. The compounds employed in the investigation were methylmercuric chloride, phenylmercuric acetate and mercuric nitrate. The retention of mercury was determined radiometrically on individual tissues and on blood and feces. The effect of prefreezing the samples, prior to the lyophilization cycle, was also studied.

13494. Reno, R. C., Swartzendruber, L. J., **Origin of Mössbauer linewidth in stainless steel,** (Proc. 18th AIP Conf. on Magnetism and Magnetic Materials, Denver, Colo., Nov. 28-Dec. 1, 1972), Paper in *Magnetism and Magnetic Materials,* C. D. Graham, Jr., and J. J. Rhyne, Eds., No. 10, 1350-1353 (American Institute of Physics, New York, N.Y., 1973).

Key words: Hyperfine fields; perturbed angular correlation, Mössbauer effect; stainless steel.

The hyperfine interactions which broaden the Mössbauer effect (ME) spectrum in austenitic stainless steel have been investigated with the aid of $^{57}Fe$ time-differential perturbed angular correlations (TDPAC). The TDPAC measurements reveal a distribution of electric field gradients at the $^{57}Fe$ nuclei with a mean value corresponding to a Mössbauer splitting of 0.14 mm/s. This splitting is not sufficient to explain the total line width and isomer shifts are invoked to account for the remaining width.

13495. Swartzendruber, L. J., Evans, B. J., **Local interactions and spin transfer mechanisms in the Heusler-type alloys $Pd_{1+x}MnSb$ and $Pd_2MnSb_{0.9}Sn_{0.1}$,** (Proc. 18th AIP Conf. on Magnetism and Magnetic Materials, Denver, Colo., Nov. 28-Dec. 1, 1972), Paper in *Magnetism and Magnetic Materials,* C. D. Graham, Jr., and J. J. Rhyne, Eds., No. 10, 1369-1373 (American Institute of Physics, New York, N.Y., 1973).

Key words: Alloys; antimony; hyperfine fields; manganese; Mössbauer effect; palladium, tin.

The magnetic hyperfine fields at $^{121}Sb$, $H_{eff}(Sb)$, in the Heusler-type alloys $Pd_{1+x}MnSb$ are found to be strongly dependent on x, varying from about 600 kG for $x=1$ to about 300 kG for $x=0$. As x is decreased from unity, the single unique value observed in $Pd_2MnSb$ is replaced by a distribution in $H_{eff}(Sb)$, with an average value which decreases in a regular manner with the number of Pd vacancies. In $Pd_2MnSb_{0.9}Sn_{0.1}$, $H_{eff}(Sn)$ is found to be similar in magnitude to $H_{eff}(Sn)$ in $Pd_2MnSn$. Both these results indicate that local spin transfer mechanisms are important in determining the magnitude and sign of $H_{eff}$ at the Sb site in Heusler-type alloys.

13496. Geltman, S., **Free-free radiation in electron-neutral atom collisions,** *J. Quant. Spectrosc. Radiat. Transfer* **13,** 601-613 (June 1973).

Key words: Bremsstrahlung; elastic scattering; free-free radiation.

Free-free absorption coefficients are calculated for the electron-neutral atom systems involving He, C, N, O, Ne, Ar, Kr, and Xe. The calculations are based upon model atomic potentials which have been adjusted to fit experimental scattering cross sections or electron affinities. Some angular distributions are presented and thermal averages are evaluated in the ranges $\lambda = 0.5 - 20\ \mu m$ and $T = 500 - 20{,}000$ K.

13497. Aras, N. K., Zoller, W. H., Gordon, G. E., Lutz, G. J., **Instrumental photon activation analysis of atmospheric particulate material,** *Anal. Chem.* **45,** No. 8, 1481-1489 (July 1973).

Key words: Air pollution; atmospheric particulate material; electron linac; photon activation analysis.

Concentrations of fourteen elements in atmospheric particulate matter have been measured by irradiation of the samples with bremsstrahlung from electrons of 35 MeV from the NBS electron linac and observation of $\gamma$ rays from the reaction products with Ge(Li) detectors. The elements routinely observed by this nondestructive method are: Na, Cl, Ca, Ti, Cr, Ni, Zn, As, Br, Zr, Sb, I, Ce, and Pb. Several other elements such as Fe, Se, Rb, and Y are marginally observable. Although, in general, instrumental photon activation analysis (IPAA) is less sensitive than instrumental neutron activation analysis (INAA), with IPAA one can measure concentrations of several elements that are difficult or impossible to measure in urban particulates with INAA, especially Ti, Ni, As, I, and Pb. Measurements of Ni, As, and Pb are quite important because of their known toxicities.

13498. Leasure, W. A., Jr., Rubin, A. I., Fath, J. M., Fisher, R. L., Flynn, D. R., **Fundamentals of noise: Measurement, rating schemes, and standards,** *Environmental Protection Agency Report No. NTID300.15,* 163 pages (Available as PB 206727 from the National Technical Information Service, Springfield, Va. 22151, Dec. 31, 1971).

Key words: Acoustics; environmental pollution; noise; sound.

This report is intended to serve as an introduction to noise, including the inter-relationship between physical measures and psychological responses. The basic principles of sound generation and propagation are discussed as well as the measurement of both the physical attributes of noise and the effects of noise on people. The suitability and effectiveness of various noise exposure rating schemes, used to estimate or predict the effects of noise on man, are discussed and critiqued. Included are sample calculations of sound level, loudness level, and perceived noise level for five selected spectra. The need is stressed for inclusion of well-defined environmental and operational requirements into measurement procedures for those devices where the noise produced is dependent on the surroundings and the operation of the device. Also presented are a glossary of pertinent acoustic terminology and a compilation of existing standards related to noise, including a brief description of the intent and scope of each.

13499. Omont, A., Smith, E. W., Cooper, J., **Redistribution of resonance radiation. I. The effect of collisions,** *Astrophys. J.* **175,** No. 1, Part 1, 185-199 (July 1972).

Key words: Collisional depolarization; level degeneracy; redistribution functions; resonance radiation.

The techniques of modern line-broadening theory are used to investigate the scattering of polarized radiation in the rest frame of an atom undergoing collisions. The formulation explicity includes both elastic and inelastic (quenching) collisions. When the lower state has zero width, a form for the redistribution function similar to that of Zanstra is obtained, but with the redistribution in the neighborhood of the resonance line being caused solely by elastic collisions. In the limit of no collisions, but with both levels of finite lifetime, the result of Weisskopf and Woolley is obtained. The effect of level-degeneracy is also explicitly included; in this case the results are a function of the polarization of the light and the different relaxation rates for the multipolar components of the atomic states.

13500. Omont, A., Smith, E. W., Cooper, J., **Redistribution of resonance radiation. II. The effect of magnetic fields,** *Astrophys. J.* **182,** No. 1, Part 1, 283-300 (May 15, 1973).

Key words: Irreducible tensor formalism; magnetic fields; resonance radiation.

Previously obtained results for scattering of radiation in the presence of collisions are restated in a density matrix formalism which employs an irreducible-tensor description of the radiation field. This formalism is particularly useful for problems

associated with radiative transfer theory. The redistribution is then extended to include the effect of a weak magnetic field. By averaging over a finite bandwidth which is on the order of the Doppler width, simplified expressions of physical significance for the scattering in the Doppler core and the Lorentz wings are obtained. Expressions are also obtained for the corresponding source function of radiative transfer theory.

**13501.** Acquisita, N., Abramowitz, S., **Vibrational spectrum of $MoF_5$,** *J. Chem. Phys.* **58,** No. 12, 5484-5488 (June 15, 1973).

Key words: Infrared; matrix isolation; $MoF_5$; Raman spectroscopy.

The infrared spectrum of matrix isolated $MoF_5$ as well as the Raman spectra of the liquid and polycrystalline species have been observed. The use of double boiler Knudsen cells has facilitated a vibrational assignment for monomeric $MoF_5$ based on a trigonal bipyramid ($D_{3h}$) structure.

**13502.** Gadzuk, J. W., Lucas, A. A., **Field-emission tails and tunneling lifetimes,** *Phys. Rev. B* **7,** No. 11, 4770-4775 (June 1, 1973).

Key words: Field emission; surfaces; tunneling.

Recent observations of high- and low-energy tails in field-emission energy distributions can be interpreted in terms of quasi-stationary-state single-particle tunneling. This imposes a restriction on the observable range of energies in such studies. The tails result from the predicted breakdown of the transfer Hamiltonian theory of tunneling when fourth-order terms in the perturbation expansion of the tunneling matrix element become large. The tunneling lifetimes $\sim 10^{-12}$ sec required to fit the experimental data are consistent with both the *RC* time constant discussed by Thornber, McGill, and Mead and also a simple intuitive picture. Alternate theories of tunneling lifetimes are critically evaluated.

**13503.** Jones, F. E., **Air density and helicopter lift,** *Joint Army-Navy Aircraft Instrumentation Research, JANAIR Report No. 721201,* 54 pages (Available as AD 754420 from the National Technical Information Service, Springfield, Va. 22151, Jan. 1973).

Key words: Air density; helicopter lift; ideal gas law.

An analysis has been made of ideal and real gas equations as they apply to the calculation of air density in the region of interest for helicopter flight. The uncertainties in calculated air density due to uncertainties in measurements of temperature, pressure and humidity have been investigated and estimates have been made of measurement accuracies which would be required to enable calculation of air density with a desired relative uncertainty. A reference system has been assembled to provide measurements of temperature, pressure and dew-point temperature aboard a helicopter. This system is to be used in making calculations of reference air density for flight tests of a system for computing hover lift margin and several devices for measuring air density. The effects on hover lift margin, defined by a simple equation, of relative uncertainties in air density and power have been investigated. Nuclear statistics as they apply to "direct" measurements of air density by application of nuclear radiation are discussed.

**13504.** Rubin, A. I., **The social impact of noise: A survey of medical, psychological, and social consequences,** *Environmental Protection Agency Report No. NTID300.11,* 25 pages (Available as PB206724 from the National Technical Information Service, Springfield, Va. 22151, Dec. 1971).

Key words: Noise; noise sources; social impact.

Noise is an environmental pollutant which shares many characteristics with other pollutants—its levels are increasing, more and more people are being affected; its consequences are medical, psychological and social. Man has been successful in producing labor-saving devices used during work and play as well as to provide many forms of transportation. However, an associated by-product is increasingly in evidence as the machines have become more powerful, namely *Noise.* Whereas only mid-city areas, heavy industries and communities near airports were formerly recognized as being "special" problems because of the noise levels associated with them; this is no longer true. Intrusive noise pervades the home, industry and most recreation areas now since, where man has moved, he has taken his machines with him. This pervasiveness of noise has led to actions by individuals, groups, and many levels of government to "do something about the problem." Among the methods attempted have been regional planning, zoning ordinances, government standards and regulations, and individual law suits. Thus far these approaches have not been successful. The number of people exposed to hazardous noise levels is increasing, the quality of our auditory environment is being degraded, and the social impact of noise may substantially contribute to other problems in our society.

**13505.** Maki, A. G., Sams, R. L., Olson, W. B., **Infrared determination of $C_0$ for phosphine via perturbation-allowed $\Delta|k-l|=\pm 3$ transitions in the $3\nu_2$ band,** *J. Chem. Phys.* **58,** No. 10, 4502-4512 (May 15, 1973).

Key words: Forbidden transitions; ground state splitting; infrared spectrum; perturbation allowed transitions; phosphine; rotational constants.

The $3\nu_2(A_1)$ and $4\nu_2 - \nu_2(A_1)$ infrared bands of $PH_3$ have been measured with high resolution. In the $\nu_2=3$ state an interaction between the $K$ and $K \pm 3$ levels gives rise to perturbation allowed $\Delta K=3$ transitions through a weak high order interaction. Since only one component of the $K=3$ levels is of the proper symmetry to interact with the $K=0$ levels there is a splitting of the $K=3$ levels. Also detectable is the splitting of the $K=3$ levels of the ground vibrational state. The measurements have been combined with microwave measurements to give accurate values for the ground state rotational constants $B_0$, $C_0$, $D_0{}^J$, $D_0{}^{JK}$, $D_0{}^K$, $H_0{}^J$, $H_0{}^{JJK}$, and $H_0{}^{JKK}$. The absence of observable inversion effects sets an upper limit of about 0.02 $cm^{-1}$ for the inversion splitting of the $4\nu_2$ level.

**13506.** Keplinger, M. S., **The case for invisible copies,** *Proc. 33d Annual Meeting of the American Society for Information Science, Philadelphia, Pa., Oct. 11-15, 1970,* **7,** 241-243 (1970).

Key words: Computers; copyright; information storage and retrieval; infringement; input; intellectual property; proprietary rights.

The problem of control of the use of copyrighted works in computerized information storage and retrieval systems is discussed. It is concluded that such input may be considered copyright infringement under the current Copyright Revision Bill as interpreted through the teachings of recent court decisions, as well as being an infringement under the current copyright statute.

**13507.** Albers, J., Deutch, J. M., **On the rate equation description of spectral lines,** *Chem. Phys.* **1,** No. 2, 89-98 (Mar./Apr. 1973).

Key words: Correlation function; density expansion; kinetic equations; Langevin equation; rate equations; scattering theory.

We present a derivation of an exact, low-density equation of motion for the generating operator $G_{ij}(t) = \exp(iLt)|j\rangle\langle i|$. For the case of foreign gas pressure broadening, the equation for $G_{ij}(t)$ may be used to obtain an exact rate equation for the line amplitude operator. Under certain well-defined approximations, this rate equation reduces to the form of an equation proposed by Gordon. The origin of the linear density term is considered. We discuss the implications of the use of only completed collisions to describe the spectrum.

**13508.** Martin, W. C., **Some aspects of the energy-level structures of lanthanide atoms and ions,** *Opt. Pura Apl.* **5,** No. 3, 181-191 (1972).

Key words: Atomic spectra; energy levels; rare earths.

The development of our understanding of some main features of these structures is reviewed, and the present degree of completeness of the analyses and theoretical interpretations of the spectra is indicated. Energy differences of the type $4f^{N-1}nl(6s^M) - 4f^N(6s^M)$(with each configuration represented by its lowest level) are of special importance, both for the analyses of a number of the spectra and for the interpretation of certain basic data for metals and compounds of these elements. The general behavior of such differences as a function of N is understood, and the resulting graphs are very similar to the d-shell energy-difference graphs studied by Catalán, Rohrlich, and Shenstone, and by Racah. The data confirm striking regularities among the f-shell graphs, first used by Racah, that yield predictions of unknown system differences and, for third and higher spectra, of ionization energies ($M = 0, n = \infty$).

**13509.** Huggett, C., **Carpet flammability and the NBS corridor fire program,** *ASTM Stand. News* **1,** No. 5, 16-20 (May 1973).

Key words: Carpets; corridor fires; fire test; flammability; floor coverings.

The NBS corridor fire program was designed to study the effects of configuration, fuel loading and distribution, ventilation, and other design parameters on the spread of fire through corridors in multiple occupancy buildings. A fully instrumented 8 ft $\times$ 8 ft $\times$ 30 ft corridor is used to carry out full-scale experiments. Fires are started in a connecting 8 ft $\times$ 8 ft $\times$ 9 ft fire room and the rate and intensity of fire spread in the corridor is observed.

Floor coverings have received special attention during the initial phase of the program. With a sufficiently intense room fire source, fire can spread rapidly over the surface of a carpet in the corridor, even with noncombustible wall and ceiling surfaces. Radiative energy transfer to the carpet surface appears to be the controlling mechanism. When the carpet starts to burn, additional energy feedback causes an accelerated propagation down the corridor. The fire spread is characterized in terms of critical energy input necessary to cause propagation, rate of fire spread, and energy contribution of the carpet to the fire.

Results of typical experiments are described. Preliminary experiments relating to the development of a test method to assess the hazard potential of floor coverings in building, based on a critical energy concept, are described.

**13510.** Craw, A. R., **A comparison of several methods for forecasting U.S. traffic fatalities,** *NBSIR 73-189,* 45 pages (May 1973). (Available as COM 73-11173 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Exponential smoothing; forecasting; time-series; traffic fatalities.

This is a second report to the Mathematical Analysis Division of the National Highway Traffic Safety Administration (NHTSA) on the subject of forecasting annual highway fatalities. This report concerns a comparison of several time series analysis programs based on exponential smoothing and nondecompositional methods currently employed by NHTSA for projecting the annual *traffic* fatalities for the entire U.S. Several methods of data aggregation are studied.

It is found that there is some advantage in using lumped (pooled) data for each region aggregated either quarterly or half yearly, and using the Sum of Regional estimates to estimate the national value.

Also, there does not appear to be any great difference in the results obtained using the nondecompositional methods and those obtained by time-series analysis programs based on exponential smoothing methods.

Estimates for the 1972 and 1973 national traffic fatalities by a variety of methods were made. For 1973 the estimates ranged from a low of 54186 to a high of 55994, with a mean of 55055.

**13511.** Moriarty, J. E., **City 1: Player's Manual,** *NBSIR 73-110,* 149 pages (Mar. 1973). (Available as COM 73-11191 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: City; computer; directors; economic; games; government; metropolitan; players; sectors; simulation; social; urban.

City I is an operational simulation game in which participants make economic, government, and social decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participant's decisions as any real city would. Each player in City I is assigned to a team which shares an economic and governmental role. This manual describes the player details for the economic and government sectors along with general information required for game play. It is one of three manuals necessary for game play. (Player's Manual, Director's Manual, Computer Operator's Manual). Each of these manuals are designed to be used for reference and by themselves will not describe enough details for a complete game play.

**13512.** Peterson, R. L., **Kinks in the magnetophonon oscillations of semiconductors,** *Phys. Rev. B* **7,** No. 12, 5405-5408 (June 15, 1973).

Key words: Magnetophonon effect; semiconductors; transport theory.

Exact expressions for the discontinuities in the magnetic field derivative of the longitudinal drift mobility at the magnetophonon resonance and pseudoresonance fields are given for nonpolar semiconductors with combined optic- and acoustic-phonon scattering of carriers. The reasons for the discontinuities are discussed in physical terms.

**13513.** McCamy, C. S., **Properties of photographic films related to information recovery,** *SPIE Seminar Proc. on Image Information Recovery, Philadelphia, Pa., Oct. 24-25, 1968,* **16,** 11-19 (Society of Photo-Optical Instrumentation Engineers, Redondo Beach, Calif., 1969).

Key words: Image processing; photographic films; photographic information.

New concepts, terminology, and symbolic notation simplify the precise treatment of optical density, which is the fundamental quantity in information recovery. The resolving power of optical and photographic systems may be treated as discrete or statistical, visual or instrumental and may be a guide to information capacity. The photographic spread function is the key to un-

derstanding image formation. The ambiguity of the modulation transfer function requires recourse to more rigorous analytic methods. Granularity, spatial effects of processing, temporal effects, and dimensional stability are important considerations in information recovery.

**13514.** Powell, C. J., **Contrasting valence-band Auger-electron spectra for silver and aluminum,** *Phys. Rev. Lett.* **30,** No. 23, 1179-1182 (June 4, 1973).

Key words: Aluminum; Auger electron transitions; electronic density of states; final state effects; silver; transition probabilities.

Measurements of the $L_{2,3}VV$ ($V$=valence) Auger spectrum of aluminum and the $M_{4,5}VV$ Auger spectrum of silver cannot be simply related to the valence-band density of states. The data for Al indicate a strong energy variation of the transition probability. For silver, the position and shape of the Auger spectrum are associated with multiplet splitting of localized double-$d$-hole final states.

**13515.** Robertson, A. F., Rappaport, M. W., **Fire extinguishment in oxygen enriched atmospheres,** *NASA CR-121150,* 60 pages (National Aeronautics and Space Administration, Washington, D.C., Feb. 1973).

Key words: Controlled atmospheres; extinguishing; fire extinguishers; fires; halons; oxygen; spacecraft cabin atmospheres; water.

Current state-of-the-art of fire suppression and extinguishment technique in oxygen enriched atmosphere is reviewed. Four classes of extinguishment action are considered: cooling, separation of reactants, dilution or removal of fuel, and use of chemically reactive agents. Current practice seems to show preference for very fast acting water spray applications to all interior surfaces of earth-based chambers. In space, reliance has been placed on fire prevention methods through the removal of ignition sources and use of nonflammable materials. Recommendations are made for further work related to fire suppression and extinguishment in oxygen enriched atmospheres, and an extensive bibliography is appended.

**13516.** Pierce, E. T., Kelly, K. L., McPherson, M. A., Howett, G. L., Booker, R. L., **Emergency vehicle warning devices: Interim review of the state-of-the-art relative to performance standards,** *LESP-RPT-0501.00,* 73 pages. Available as PB211938 from the National Technical Information Service, Springfield, Va. 22151, (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1972).

Key words: Action; communication; conspicuity; controlled environment; effectiveness; flashing lights; guidelines; information; laboratory testing; people; response; sirens; standards.

This interim progress report describes the activities carried out, from the initiation of the program through July 1971, concerning the preparation of performance standards for emergency vehicle warning devices (lights and sirens). A partial survey of present standards and specifications indicated that there now are very few meaningful performance standards for emergency warning lights and essentially none for sirens. Brief descriptions of those standards which were found are included. Manufacturer's literature on available warning devices rarely includes meaningful quantitative data on the physical performance characteristics of either lights or sirens. The program strategy described in this report includes (a) quantitative physical characterization of the spectral content, directionality, level, and time duration of the signals from a representative sampling of emergency vehicle warning equipment; (b) literature and laboratory study of the effectiveness of representative signals in alerting drivers to an emergency situation requiring appropriate reactions; and (c) development of draft standards. In conjunction with the physical characterization of lights and sirens, examples are given of the type of data which will be taken and detailed descriptions are given of the facilities which will be used for these measurements. A discussion is given of the various factors which influence the effectiveness of warning signals. It is proposed to study both the time elapsing between the occurrence of a signal and the completion of the required response (complex reaction time) and the distance at which an observer first notices and correctly interprets a signal (recognition distance). Performance standards can then be prepared which are clearly related to the appropriate human responses.

**13517.** Sullivan, D. B., **Precise electrical measurements at low temperature,** *Proc. 1972 Applied Superconductivity Conf., Annapolis, Md., May 1-3, 1972,* pp. 631-639 (IEEE, Inc., New York, N.Y., 1972).

Key words: Fundamental constants; Josephson effect; precise electrical measurements; superconductivity.

The application of low temperature phenomena to electrical metrology is reviewed. The review includes a number of recent developments which involve measurement systems based on the quantum of magnetic flux as well as adaptations of classical concepts to low temperature devices. Quantities considered include radio frequency current, infrared frequency, and direct current and voltage. Concepts for secondary emf standards are also discussed.

**13518.** Brower, W. S., Parker, H. S., Roth, R. S., **Synthesis of mercury bismuth sulfide $HgBi_2S_4$,** *Mater. Res. Bull.* **8,** 859-862 (1973).

Key words: Bismuth; mercury; sulfides; synthesis.

The compound $HgBi_2S_4$ was found to be the only phase present, other than the end members, in mixtures of HgS and $Bi_2S_3$. The compound is apparently a new structure type with monoclinic symmetry, space group C2, Cm or C2/m $a=14.179$, $b=4.0555$, $c=13.986$ Å, $\beta=118°13.8'$.

**13519.** Hall, J. L., Bordé, C., **Measurement of methane hyperfine structure using laser saturated absorption,** *Phys. Rev. Lett.* **30,** No. 22, 1101-1104 (May 28, 1973).

Key words: Hyperfine spectrum; laser stabilization; methane; spectroscopy.

With optical resolution above $10^{10}$, we study hyperfine structure in the methane vibration-rotation line at 3.39 $\mu$m. Doppler-generated crossing resonances were observed in addition to the resolved $\Delta F=0$ and $-1$ lines. Splittings in both ground and excited states were determined. Differential saturation of such hyperfine structure will lead to an intensity-dependent shift in many molecularly stabilized lasers.

**13520.** McCamy, C. S., Pope, C. I., **The stability of silver-gelatin images,** (Proc. 2d Int. Congress on Reprography, Cologne, Germany, Oct. 25-31, 1967), Paper A3-1 in Section A3 of *Reprographie* **II,** 112-115 (Verlag Dr. Othmar Helwich, Darmstadt, Germany und Wien, Austria, 1969).

Key words: Aging blemishes; blemishes, microfilm; film storage; microfilm; microfilm image stability.

Though microfilm has been in commercial use in the United States for 40 years, recent observations of blemishes on film have occasioned a re-evaluation of factors affecting long-term stability. Six types of blemishes appear to be the result of oxida-

tion-reduction reactions initiated by gaseous reactants. These reactants are traceable to the cardboard containers in which reels of film have been stored. Statistical analysis of data gathered by 100 film inspectors supports this conclusion. Laboratory experiments ruled out biological causes. Experiments prove the existence of oxidizing and reducing agents, formaldehyde, and formic acid in the atmosphere within cardboard containers. Appropriate films, properly processed and stored in inert containers, at a relative humidity under 40 percent and temperature under 21 °C, should be as durable as the best record paper.

13521. Brown, W. E., **Solubilities of phosphates and other sparingly soluble compounds,** Chapter 10 in *Environmental Phosphorus Handbook*, E. J. Griffith, A. Beeton, J. M. Spencer and D. T. Mitchell, Eds., pp. 203-239 (John Wiley & Sons, Inc., New York, N.Y., 1973).

Key words: Calcium carbonates; calcium phosphates; hydroxyapatite; limnetic phosphate; phase diagrams; phosphate pollution; solubility.

Solubilities of five calcium phosphates, $Ca_5(PO_4)_3OH$, $\beta-Ca_3(PO_4)_2$, $Ca_8H_2(PO_4)_6 \cdot 5H_2O$, $CaHPO_4$, and $CaHPO_4 \cdot {}_2H_2O$ must be considered as factors that may limit the concentrations of calcium and orthophosphate ions in natural waters. In the three-dimensional plot pH vs $[Ca(OH)_2]$ and $[H_3PO_4]$ for all solutions in the ternary system, $Ca(OH)_2$-$H_3PO_4$-$H_2O$, one obtains a surface that (i) has an important bearing on the positions of the isotherms for the five calcium phosphates and the fact that the isotherms have negative slopes, and (ii) is a consequence of the fact that $H_3PO_4$ is a polybasic, weak acid.

The phase diagram for the ternary system can be expanded to approximate a four component system in which the effects of all other components are incorporated into a single variable which is a measure of their net basicity or acidity. This diagram should have considerable value in the interpretation of field data. Lines of constant pH on this diagram can be used to determine whether a solution is undersaturated or supersaturated with respect to the salt under consideration. Other lines on this diagram define compositions along which the chemical potentials of $Ca(OH)_2$, $H_3PO_4$ and the various calcium phosphate salts are all constant.

Potential diagrams ($-$ log of the activity of $Ca(OH)_2$ plotted vs that of $H_3PO_4$) are useful for establishing (i) the degree of saturation of a given solution with respect to anyone or all of the calcium phosphates, and (ii) the Ca/P ratio of the saturating solid phase.

A variety of theoretical and experimental factors must be taken into account in the design of solubility measurements and in the interpretation of results. Their application to calcium phosphates and other sparingly soluble salts of polybasic acids is described.

13522. Waterstrat, R. M., Dickens, B., **The crystal structure of $V_3Rh_5$,** *J. Less-Common Metals* **31,** 61-67 (1973).

Key words: Atomic ordering; crystal structures; intermetallic compounds; rhodium alloys; vanadium alloys.

The crystal structure of the phase $V_3Rh_5$ has been elucidated. The unit cell is orthorhombic with $a=5.420$ Å, $b=9.276$ Å, $c=4.320$ Å and $Z=2$; the space group is either *Cm2m* or *Cmcm*. The structure is close-packed and contains both ordered and disordered atomic sites. It is intermediate between the structures of the $Cu_3Au$ and CuAu types except that it possesses a two-layer stacking sequence.

13523. McCamy, C. S., Pope, C. L., **Redox blemishes— their cause and prevention,** (Proc. National Microfilm Association, Boston, Mass., May 7, 1969), *J. Microgr.* **3,** No. 4, 165-170 (June 1970).

Key words: Archival records; microfilm; redox blemishes.

A type of small spots and character-associated defects on some microfilm were investigated by a variety of techniques. The blemishes result from the displacement of image silver by an oxidation-reduction reaction caused by peroxides and other gaseous products of degradation of the paper cartons in which the films are stored. A method of producing blemishes for test purposes was developed. Recommendations cover the materials, processes, and storage conditions for microfilm preservation of records of permanent value.

13524. Schneider, S. J., Levin, E. M., **Polymorphism of $K_2CO_3$,** *J. Amer. Ceram. Soc.—Discussions and Notes* **56,** No. 4, 218-219 (1973).

Key words: DSC; DTA; high temperature x-ray; $K_2CO_3$; phase transformation; polymorphs.

The polymorphism of $K_2CO_3$ was investigated by differential thermal analysis, differential scanning calorimetry and high temperature x-ray diffraction techniques. The data indicate that $K_2CO_3$ is dimorphic with a 2nd order transformation from a monoclinic form to a hexagonal modification occurring at $420 \pm 5$ °C. Unit cell dimensions as a function of temperature and a representative x-ray powder pattern of hexagonal $K_2CO_3$ are given.

13525. Okabe, H., Splitstone, P. L., Ball, J. J., **Ambient and source $SO_2$ detector based on a fluorescence method,** *J. Air Pollut. Contr. Ass.* **23,** No. 6, 514-516 (June 1973).

Key words: Air pollutant; detector, fluorescence; $SO_2$.

The principle of this detector is based on the measurement of the intensity of the ultraviolet fluorescence of $SO_2$ produced by absorption of the Zn 2138 Å or Cd 2288 Å line. The fluorescence intensity was found to be linear from 0.1 to 500 ppm of $SO_2$ in air with the Zn lamp and from 0.1 to 1600 ppm with the Cd lamp. The detection limit at present is about 20 ppb. There is no detectable interference from $O_3$, $H_2S$, $NO_2$, $CO_2$, CO, or $H_2$, although the presence of a large concentration of $CS_2$ (500 times as much as $SO_2$) NO (500 times) or $C_2H_4$ (4000 times) interferes with the measurement. The presence of 2 percent $H_2O$ reduces the signal by 25 percent, while up to 1 percent $CH_4$ has almost no effect.

13526. Heinrich, K. F. J., **The application of Monte-Carlo calculations in electron probe microanalysis,** *Proc. of the Seminar on Quantitative Analysis with Electron Microprobes and Secondary Ion Mass Spectrometry, Jülich, Germany, Oct. 18-20, 1972,* pp. 149-155 (Mar. 1973).

Key words: Data reduction; electron probe; Monte-Carlo calculations; thin layers.

The simulation of electron trajectories by means of the Monte-Carlo calculations offers an attractive alternative to the conventional data reduction procedures in electron probe microanalysis. It is particularly flexible with regard to specimen geometry, and should be very useful for the analysis of thin films and similar materials. However, as in the conventional procedures, approximations and empirical adjustments are necessary for the development of a useful model. The experiences derived from such a model can in turn be used to improve the conventional algebraic correction schemes.

13527. Frenkiel, F. N., Klebanoff, P. S., **Probability distributions and correlations in a turbulent boundary layer,** *Phys. Fluids* **16,** No. 6, 725-737 (June 1973).

Key words: Boundary layer; correlations; higher-order moments; high-speed computing; hot-wire anemometry; probability distributions.

One-dimensional and joint probability density distributions for longitudinal components of turbulent velocities as well as higher-order correlations are measured in a turbulent boundary layer on a flat plate using hot-wire anemometry and high-speed computing methods. The effect of the nonlinear response of the hot-wire is taken into account. Data pertaining to the general nature of the turbulent boundary layer are presented and comparison is made between the measured correlations and those corresponding to a Gaussian probability distribution of turbulent velocities as well as to non-Gaussian distributions of the Gram-Charlier type. Similar comparisons are made of the measured one-dimensional and joint probability distributions. Probability distributions in the boundary layer are also compared to those measured downstream of a grid. The closure of the tails of the probability distribution and its effect on the accuracy of the measurements of higher-order moments is considered.

**13528.** Atkinson, G. H., Laufer, A. H., Kurylo, M. J., **Detection of free radicals by an intracavity dye laser technique,** *J. Chem. Phys.* **59,** No. 1, 350-354 (July 1, 1973).

Key words: Absorption; flash photolysis; free radicals; laser; spectra.

A new technique for the detection of free radicals inside the cavity of a dye laser is described. This intracavity absorption phenomenon has two important advantages: (1) It has the potential for quantitative detection suitable for kinetic studies of transient chemical species and (2) it has a high degree of sensitivity. In the present work, the technique is shown to be at least as sensitive as, and most probably several orders of magnitude more sensitive than, previous methods for the detection of transients. It is presently a powerful tool for obtaining high resolution spectra as well as obtaining precise information about the energy distribution of transient species produced photolytically or kinetically. Spectra for both $NH_2$ and HCO (produced flash photolytically) are presented.

**13529.** Feldman, A., Horowitz, D., Waxler, R. M., **Laser damage in materials,** *NBSIR 73-119,* 52 pages, (Feb. 1973). (Available as AD 757789 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Absorption coefficient; damage threshold; electrostrictive self-focusing; electrostriction; Kerr effect; laser damage; nonlinear index of refraction; self-focusing; thermal self-focusing.

The relative contributions of the Kerr, electrostrictive, and thermal effects to the self-focusing thresholds of borosilicate crown glass, fused silica, and dense flint glass have been estimated from an analysis of damage threshold data for linearly polarized and circularly polarized radiation. The measurements were made with a Nd:glass laser operating in the $TEM_{00}$ mode with a temporal pulse width of 25 ns. The Kerr effect appears to be the largest effect. The thermal effect is also significant. The electrostrictive effect is smallest. Reasonable values of absorption coefficient are calculated from the thermal contribution. The results are in qualitative agreement with the work of others. Self-focusing data obtained with linearly polarized and circularly polarized radiation are presented for yttrium aluminum garnet (YAG) and five commercial Nd:doped laser glasses. The YAG data agree with the theory of self-focusing. Near the threshold the laser glass data appear to indicate intrinsic damage rather than self-focusing. Differences between the various laser glasses are small. Self-focusing data obtained in dense flint glass with a longer focal length lens are also presented. An electro-optic shutter actuated by a laser triggered spark gap is discussed.

**13530.** Lee, T. G., Huggett, C., **Interlaboratory evaluation of the tunnel test (ASTM E 84) applied to floor coverings,** *NBSIR 73-125,* 56 pages, (Mar. 1973). (Available as COM 73-11189 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: ASTM E 84; building materials; carpets; fire tests; flame spread tests; interlaboratory evaluation; round robin; statistical analysis; test method standard.

Results of an interlaboratory evaluation of the ASTM E 84 tunnel test method involving eleven laboratories and nine materials, including four carpets, are reported. Data on flame spread, smoke, and fuel contribution are analyzed statistically. Selected physical characteristics of each tunnel are tabulated and compared relative to specifications in the test method. The between-laboratory coefficient of variation (reproducibility) in flame spread classification (FSC) was found to range from 7 to 29% for the four carpets and from 18 to 43% for the other materials tested. The between-laboratory coefficients of variation for smoke developed and fuel contribution ranged from 34 to 85% and from 22 to 117% respectively for all materials tested. The causes of higher variability in smoke and fuel contribution measurement between laboratories is not definitely known but may reasonably be attributed to variations in tunnel construction, maintenance, and operation, in the location of photometers, and in the mounting of thermocouples in different laboratories. Some variability of results may possibly be due to variation in test specimens. Variation in construction and measurement techniques among tunnels may be minimized by updating the test method standard.

**13531.** Koonce, C. S., **Theory of superconducting semiconductors,** (Proc. of a Summer Course on The Science and Technology of Superconductivity, held at Georgetown University, Washington, D.C., Aug. 13-26, 1971). Paper in *The Science and Technology of Superconductivity,* W. D. Gregory, W. N. Mathews, Jr., and E. A. Edelsack, Eds., **1,** 373-387 (Plenum Press, New York, N.Y., 1973).

Key words: Energy gap equation; semiconductors; superconductor; transition temperature.

The BCS theory of superconductivity will be applied to degenerate semiconductors. Methods of calculating superconducting properties of degenerate semi-conductors will be compared with methods used to calculate superconducting properties of metals. The normal state properties of degenerate semiconductors which are important in determining the superconducting properties will be discussed.

**13532.** Koonce, C. S., **Enhancement effects: Theory,** (Proc. of a Summer Course on The Science and Technology of Superconductivity, held at Georgetown University, Washington, D.C., Aug. 13-26, 1971). Paper in *The Science and Technology of Superconductivity,* W. D. Gregory, W. N. Mathews, Jr., and E. A. Edelsack, Eds., **1,** 389-403 (Plenum Press, New York, N.Y., 1973).

Key words: Dielectric function; superconductor; transition metal; transition temperature.

A discussion of which modifications of normal state properties such as phonon frequencies and electronic density of states as a function of energy are likely to enhance the superconducting transition temperature will be given. A discussion of the methods of modification of the material properties such as alloying, doping applying pressure and forming thin films will also be given.

**13533.** McLaughlin, W. L., Kosanić, M., Draganić, I. G., **Extending the response of the pararosaniline dye system,** (Proc.

Int. Symp. on Dosimetry in Agriculture, Industry, Biology and Medicine, Vienna, Austria, Apr. 1972), Paper in *Dosimetry in Agriculture, Industry, Biology and Medicine*, pp. 362-366 (International Atomic Energy Agency, Vienna, Austria, 1973).

Key words: Dosimetry; dyes; gamma rays; nitrobenzene; oxidation; pararosaniline cyanide; radiochromic dyes; triphenylmethane dyes.

Organic solutions of triphenylmethane dye precursors, particularly pararosaniline cyanide (4, 4′, 4″ -triamino-triphenylacetonitrile) and hexa (hydroxyethyl) pararosaniline cyanide (4, 4″, 4″ -tris- (di-β-hydroxyethylamino) triphenylacetonitrile, have been used successfully in measuring gamma-ray absorbed doses in the range from 1 to 100 krad. With conventional slightly acidified and aerated ether alcohol solutions of the dye precursors, the optical density read at the absorption maximum in the visible portion of the spectrum increases linearly with dose up to about 100 krad. Saturation and bleaching of the solutions at doses between 100 and 200 krad limit the usefulness of these liquid systems. A recent study has been performed at the Boris Kidric Institute of Nuclear Sciences and the Danish Atomic Energy Commission, Research Establishment Risø, for the purpose of making chemical adjustments in the solutions so that higher absorbed doses may be measured with a linear optical density-versus-dose response.

**13534.** McCamy, C. S., **The evaluation and manipulation of photographic images,** Chapter in *Picture Processing and Psychopictorics*, A. Rosenfeld and B. S. Lipkin, Eds., 57-74 (Academic Press, Inc., New York, N.Y., 1970).

Key words: Image evaluation; image manipulation; image optics; photography.

The scientific use of photography in the study of the psychophysics of images requires a knowledge of the techniques employed in specifying the characteristics of optical and photographic systems and the available techniques for manipulating photographic images. The primary measure of the photographic effect is *optical density*, a quantity which depends on the method of measurement in a complex way. The photographic process is quantitatively characterized by sensitometry. Image structure is characterized by resolving power, spread function, modulation transfer function, pupil function, acutance, and granularity. Photographic images may be manipulated by various forms of dodging, masking, and special processing.

**13535.** Olien, N. A., Sarkes, L. A., **Keeping up with LNG—a new literary awareness service helps to do the job,** *Amer. Gas Ass. Mon.* **55,** No. 7-8, 29 and 31 (July-Aug. 1973).

Key words: Current awareness services; information retrieval; information systems; Liquefied Natural Gas; methane; methane mixtures.

A description is given of the methods used by the Cryogenic Data Center in covering the current published and patent literature. The services provided to the Cryogenic industry are also discussed. The *Liquefied Natural Gas Quarterly* which has been published since 1970 is covered in detail. It is noted that nearly 2,000 articles, papers, reports, and patents dealing with LNG have been listed in the twelve issues of the quarterly published to date. A series of comprehensive bibliographies on LNG, methane, and methane mixtures is also described.

**13536.** Kirchhoff, W. H., **Microwave spectroscopy,** *Chem. Eng. News* **47,** 88-98 (Mar. 24, 1969).

Key words: Dipole moment; microwave spectroscopy; molecular rotation; molecular structure; qualitative analysis; quantitative analysis.

A review of microwave spectroscopy is presented with special emphasis on its applications to problems of chemical interest. The fundamental concepts of molecular rotation are discussed using classical mechanics, and the relationship of molecular structure and forces with the molecular rotation is presented. The quantum mechanical model is then presented with sufficient detail to understand the nature of rotational spectroscopy. The Stark effect and its dependence on the molecular dipole moment is briefly described. Recent instrumental advances as well as the application of microwave spectroscopy to quantitative and qualitative analysis are mentioned.

**13537.** Reed, R. P., Arvidson, J. M., Durcholz, R. L., **Tensile properties of polyurethane and polystyrene foams from 76 to 300 K,** (Proc. 1972 Cryogenic Engineering Conf., Boulder, Colo., Aug. 9-11, 1972), Paper E-3 in *Advances in Cryogenic Engineering* **18,** 184-193 (Plenum Press, New York, N.Y., 1973).

Key words: Foams; low temperature; tensile properties.

The tensile properties of 17 different polyurethane foams and 2 polystyrene foams have been measured at 300, 195 and 76 K. The Young's modulus, yield strength and tensile strength increased with decreasing temperature, while the elongation decreased. Strength and Young's modulus were found to be approximately linearly dependent on temperature; however, at low temperatures the density dependence was greater. Specimens whose long axis was cut parallel to the cell rise direction were stronger than those whose long axis was cut normal to the cell rise direction. Comparisons between foam tensile and compressive properties are presented in the accompanying paper.

**13538.** Cruz, J. E., Rogers, E. H., Hiester, A. E., **Continuous liquid level measurements with time-domain reflectometry,** (Proc. 1972 Cryogenic Engineering Conf., Boulder, Colo., Aug. 9-11, 1972), Paper H-4 in *Advances in Cryogenic Engineering* **18,** 323-327 (Plenum Press, New York, N.Y., 1973).

Key words: Coaxial probe; emptying rate; fill rate; liquid level; time domain reflectometer.

A time domain reflectometer is considered a closed-loop, one dimensional radar system. Applying the principle of time domain reflectometry to the detection of cryogenic liquid levels, measurements on the order of ±0.3% of total liquid level probe length are possible.

The time domain reflectometer liquid level measurement is independent of liquid density variations and is simple to calibrate and operate. Construction of the liquid level sensing probe is described.

**13539.** Orcutt, R. H., **Interlot density variation of a siloxane manometer fluid,** *J. Vac. Sci. Technol.* **10,** No. 4, p. 506 (July-Aug. 1973).

Key words: Diffusion pump fluid; micromanometry; silicone.

The mean value of density for six samples of a siloxane manometer fluid is 1.06311 g/cm$^3$ with an estimated standard deviation of $11 \times 10^{-5}$ g/cm$^3$ for the lot-to-lot variation in density of this fluid. From this result it is concluded that for use of this material in manometry to the 0.01% level the density of the actual fluid used must be determined.

**13540.** Schooley, J. F., **Superconductors in thermometry,** (Proc. Summer Course on The Science and Technology of Superconductivity held at Georgetown University, Washington, D.C., Aug. 13-26, 1971), Paper in *Science and Technology of Superconductivity*, W. D. Gregory, W. N. Mathews, Jr., and E. A.

Edelsack, Eds., **2**, 625-630 (Plenum Press, New York, N.Y., 1973).

Key words: Critical magnetic field; heat capacity; Josephson junctions; noise thermometry; superconductive fixed points; superconductivity; thermometry.

Various properties of superconductors show monotonic temperature dependences, so that in principle they may be used as thermometric parameters. Other properties can be utilized in devices which find convenient application in thermometry. Of the many possible examples, we will examine several which have found some actual use either as thermometers or detectors in thermometry.

**13541.** Arvidson, J. M., Durcholz, R. L., Reed, R. P., **Compressive properties of polyurethane and polystyrene foams from 76 to 300 K,** (Proc. 1972 Cryogenic Engineering Conf., Boulder, Colo., Aug. 9-11, 1972), Paper E-4 in *Advances in Cryogenic Engineering* **18**, 194-201 (Plenum Press, New York, N.Y., 1973).

Key words: Compression; foams; temperature.

The compressive properties of 4 different polyurethane foams and 2 polystyrene foams have been measured at 300, 195 and 76 K. Similar to tensile properties, the Young's modulus, yield strength, and compressive strength increased with decreasing temperature, while the elongation to fracture decreased. An approximate linear dependence on density was found for Young's modulus in compression and the proportional limit. Longitudinal specimens were usually stronger than transverse specimens. Specimens pulled in tension were considerably stronger than specimens loaded under compression, but these differences diminished at lower temperatures.

**13542.** Wells, J. S., **A stabilized HCN laser for infrared frequency synthesis,** *IEEE Trans. Instrum. Meas.* **IM-22**, No. 2, 113-118 (June 1973).

Key words: HCN laser; infrared frequency synthesis; laser frequency measurements; laser stabilization; laser metrology; phase locked laser.

Infrared frequencies have recently been synthesized in suitable diodes up to 88 THz with accuracies of parts in $10^9$. Stabilized lasers are necessary in order to make frequency measurements of higher accuracy. The hydrogen-cyanide laser is the lowest frequency basis laser used in these synthesis schemes, and its stabilization has been the subject of recent interest. The laser is stabilized by locking it to a phase-locked microwave reference chain. Two servo loops are utilized. The first loop is a relatively slow frequency-lock loop with the correction applied to a piezoelectric-translator driver. This loop not only accommodates thermal expansion of the laser, but also serves as an acquisition aiding loop for the second servo. The latter is a phase-locked system with the correction applied to the laser discharge current controller. Data regarding the system stability are presented.

**13543.** Geist, J., **Theoretical analysis of laboratory blackbodies. 1: A generalized integral equation,** *Appl. Opt.* **12**, No. 6, 1325-1330 (June 1973).

Key words: Blackbody; holrahm radiation; radiometry; thermal radiative transfer.

The integral equations describing radiative equilibrium in a blackbody cavity are presented. Solving these equations in terms of the power sources in the furnace surrounding the cavity is not practical. However, if provisions are made for measuring the temperature over some surface between the power sources and the cavity interior, the analysis is feasible. This restriction and some realistic assumptions lead to a single, linear, inhomogeneous integral equation that approximately describes the interaction of the cavity geometry, the thermal radiative properties of the cavity wall, and the temperature gradients within the cavity in reducing the quality of the blackbody. The formulation is general enough to accomodate realistic reflectance and temperature distributions for high quality blackbodies, and the accuracy of calculations based upon it will probably not be limited by approximations involved in its derivation, but by the present state of the art in the knowledge of the thermal radiative properties of materials.

**13544.** Schooley, J. F., **Enhancement effects,** (Proc. Summer Course on The Science and Technology of Superconductivity, held at Georgetown University, Washington, D.C., Aug. 13-26, 1971), Paper in *The Science and Technology of Superconductivity*, W. D. Gregory, W. N. Mathews, Jr., and E. A. Edelsack, Eds., **1**, 405-428 (Plenum Press, New York, N.Y., 1973).

Key words: High transition temperature; pressure effects; proximity effect; superconductive alloys; superconductive compounds; superconductivity.

Superconductivity research has had as one of its continuing aims the production of high-transition-temperature materials. This situation arises from the realization that superconductivity can be applied to transportation, communication, power transmission, and instrumentation on a wider and more efficient basis, the higher the transition temperature. Many of these applications will be discussed during this course by several of the lecturers.

In this lecture, I will discuss various ways in which experimenters have attempted to generate high transition temperatures.

**13545.** Milligan, D. E., Jacox, M. E., **Infrared spectroscopic evidence for the stabilization of $HAr_n^+$ in solid argon at 14 K,** *J. Mol. Spectrosc.* **46**, No. 3, 460-469 (June 1973).

Key words: Argon reactions; $H(^2S)$ reaction with Ar: $HAr_n^+$: infrared spectrum; interstitial H atom spectrum; matrix isolation; proton affinity; vacuum ultraviolet photolysis.

Absorptions which have been observed at 905 and at 644 $cm^{-1}$ upon 1216-Å photolysis of hydrogen- and deuterium-containing compounds, respectively, in an argon matrix correspond well with similar absorptions reported in studies of the trapped products of a glow discharge through $Ar:H_2$ and $Ar:D_2$ mixtures. Evidence is presented supporting the assignment of these two absorptions to $HAr_n^+$ and to $DAr_n^+$ rather than to interstitial H and D atoms trapped in octahedral sites in the argon lattice.

**13546.** Cohen, J., Edelman, S., Vezzetti, C. F., **Pyroelectricity and piezoelectricity in oriented films of polyvinyl fluoride and polyvinylidene fluoride,** (Proc. Conf. on Electrets, Charge Storage and Transport in Dielectrics, Miami Beach, Fla., Oct. 8-13, 1972), Paper in *Electrets, Charge Storage and Transport in Dielectrics*, Martin M. Perlman, Ed., pp. 505-516 (The Electrochemical Society, Inc., Princeton, N.J., 1973).

Key words: Piezoelectricity; poling; polyvinyl fluoride; polyvinylidene fluoride; pyroelectric coefficient; pyroelectricity.

Improved pyroelectric and piezoelectric activities have been produced in films of polyvinyl fluoride (PVF) and polyvinylidene fluoride ($PVF_2$). The phenomena are ascribed to orientation of dipoles normal to the plane of the film. Activity is developed or enhanced by applying intense electrical fields across the films at



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elevated temperatures and cooling to room temperature with the field still applied (poling). The $PVF_2$ films are usually stretched before poling, and this is found to increase both pyroelectric and piezoelectric effects. Room temperature pyroelectric coefficients for these materials have been estimated from measurements of voltage responsivity, and pyroelectric coefficients comparable to that of triglycine sulfate (TGS) have been obtained. Observations of the correlation between the thermal radiation effects and the piezoelectric activity suggest that the former are pyroelectric. A method has been developed to study the poling process.

**13547.** Geist, J., **New NBS scale of irradiance,** *Appl. Opt.* **12,** No. 4, 907-908 (Apr. 1973).

Key words: Electrically calibrated detectors; irradiance; total irradiance.

This letter presents a short report on the new NBS scale of total irradiance that was recently realized with an electrically calibrated detector. The results of intercomparisons of two such detectors as well as a comparison of the new scale with the old scale as maintained at NBS are presented.

**13548.** Grabner, L., Wong, E. Y., **Zeeman effect of no-phonon $^4A_{2g}$ - $^4T_{2g}$ transition of $Cr^{3+}$ in $TiO_2$,** *Phys. Rev. B* **8,** No. 3, 1032-1037 (Aug. 1, 1973).

Key words: $Cr^{3+}$ in $TiO_2$; identification of excited state; $^4A_{2g}$ - $^4T_{2g}$ transition; Zeeman effect.

The site symmetry of $Cr^{3+}$ in $TiO_2$ is $D_{2h}$ which splits the cubic ($O_h$) $^4T_{2g}$ state into $^4B_{1g}$, $^4B_{2g}$, and $^4B_{3g}$. Spin-orbit interaction further splits these states into six Kramers doublets all of symmetry $\Gamma_5^+$. Previous optical work on $TiO_2$: $Cr^{3+}$ established the lowest-lying sharp lines at 12685 and 12732 $cm^{-1}$ as no-phonon lines of magnetic dipole character. It proposed these lines as due to transitions between the $^4A_{2g}$ ground state and two of the above six states. The present report extends this work by a Zeeman study, in emission, at 4 K of the line at 12685 $cm^{-1}$. The results are: The Zeeman splitting of this line identifies the excited state of this transition as the $M_s = \pm 3/2$ spin-orbit component of an orbital state consisting of 77% $^4B_{2g}$, 17% $^4B_{1g}$, and 6% $^4B_{3g}$ with an effective $g = 1.73$. Furthermore, the line at 12732 $cm^{-1}$ is identified as the $M_s = \pm 1/2$ spin-orbit component by its effect in second order in the magnetic field on the Zeeman pattern of the line at 12685 $cm^{-1}$. For the excited state the spin is quantized along the $x$ direction of the magnetic axes while for the ground state it is quantized along the $z$ direction. The reason for spin quantization along the $x$ axis is discussed.

**13549.** Achenbach, P. R., Phillips, C. W., **Performance characteristics of pressure-actuated water-regulating valves for refrigerant condensers,** (Proc. XII Int. Congress of Refrigeration, Madrid, Spain, 1967), Paper in *Progress in Refrigeration Science and Technology* **2,** 1107-1118 (Gráficas Reunidas, Madrid, Spain, 1969).

Key words: Performance characteristics; refrigeration accessories; valves; water-flow regulation.

Water-regulating valves are used on the condensers of water-cooled refrigerating units to maintain a satisfactory refrigerant condensing pressure and to conserve water. Both pressure-actuated and temperature-actuated valves are used for this purpose. A study was made of three sizes of pressure-actuated water-regulating valves from each of three sources to determine their range of condenser pressure control, the change in condensing pressure required to move the valves from fully-closed to fully-open position, the hysteresis in the control mechanism, and the water-flow characteristics near the fully-closed position. These and other performance characteristics related to water conservation and reliable operation of refrigerating units were investigated to provide guidance to the U.S. Army Natick Laboratories in writing performance specifications. The study revealed that the nominal pipe size of the valves was not a good indication of water-flow capacity, that the sensitivity of the various valves to change in condensing pressure differed widely, and that the difference between opening and closing pressure was in excess of 10 psi (0.7 $kg/cm^2$) in some valves. Moreover, the condensing pressure at 90 percent maximum water flow rate ranged from 118 to 172 psig (8.3 to 12.1 $kg/cm^2$) for the several valves when the opening pressure was set at 80 psig (5.6 $kg/cm^2$).

**13550.** Canfield, L. R., Johnston, R. G., Madden, R. P., **NBS detector standards for the far ultraviolet,** *Appl. Opt.* **12,** No. 7, 1611-1617 (July 1973).

Key words: Detectors; far ultraviolet; ion chamber; photodiodes; radiometry; thermopile.

A program at NBS leading to the realization of practical, stable transfer detector standards for the far ultraviolet is reviewed. Three basic detector types, one covering the region of 584-1216 Å and the other two covering the region of 1164-2537 Å, are described. Examples of these detectors have been calibrated at NBS and distributed to laboratories throughout the United States and Europe, where they are being used as primary radiometric calibration references in a variety of far-uv experiments.

**13551.** Tilford, C. R., **A fringe counting laser interferometer manometer,** *Rev. Sci. Instrum.* **44,** No. 2, 180-182 (Feb. 1973).

Key words: Fringe counting; laser interferometer; manometer.

A prototype standard mercury manometer using a fringe counting laser interferometer to measure the differential height of the mercury columns has been built and successfully operated. The 10.6 $\mu$ wavelength radiation from a $CO_2$ laser and specially treated manometer tubes have been used to reduce the effect of disturbances on the mercury surface so that reliable operation of the manometer is possible.

**13552.** Roder, H. M., **A new phase transition in solid hydrogen?,** *Cryogenics Letter to Editors* **13,** No. 7, 439-440 (July 1973).

Key words: Hydrogen; phase transition.

Available but often discordant data on PVT, dielectric constant, specific heat, velocity of sound, and melting pressures are interpreted to indicate the possibility of a transition in solid hydrogen. This structural change, suggested by others previously, has not yet been investigated as thoroughly as the corresponding transition in solid helium.

**13553.** Hsieh, C., Thomson, R., **Lattice theory of fracture and crack creep,** *J. Appl. Phys.* **44,** No. 5, 2051-2063 (May 1973).

Key words: Creep of crack; fracture; lattice theory.

A quasianalytic solution for the atomic displacements of a discrete two-dimensional lattice containing a crack is obtained. We assume that the force laws are linear up to a critical displacement when the bond snaps, which is the basic assumption of the lattice static approximation. When compared to the classic Griffith continuum description, new results are: (i) a predicted and observable lattice trapping of the crack, (ii) difficulties with the interpretations of the crystal surface energy in a cleavage experiment, and (iii) a predicted characteristic crack creep phenomenon under external constant stress. The present theory shows how two separate "surface energies" are inferred from the stress to open and to close a crack, and on our model these ener-

gies differ from one another by a large factor of 5.7. The thermodynamic "surface energy" is not related to either of these quantities. Experimental verification of the lattice trapping of cracks is thought to be most readily and directly obtained by observations of the creep of a crack under high vacuum conditions.

**13554.** Fickett, F. R., **Properties of nonsuperconducting technical solids at low temperatures,** *Proc. 4th Int. Conf. on Magnet Technology,* Brookhaven National Laboratory, Upton, N.Y., Sept. 19-22, 1972, pp. 498-516 (Atomic Energy Commission, Washington, D.C., 1972).

Key words: Composite materials; electrical properties; mechanical properties; metals; plastics; review; thermal properties.

A number of physical and mechanical properties of materials used in low temperature applications are described with references to both theory and compiled data. These properties, which fall into three main groups, thermal, electrical, and mechanical, are given for pure metals, alloys, and a few nonmetals. In essence, this paper is a review of concepts and available data for low temperature engineering applications of nonsuperconductors.

**13555.** Fröhlich, C., Geist, J., Kendall, J., Sr., Marchgraber, R. M., **The Third International Comparisons of Pyrheliometers and a comparison of radiometric scales,** *Sol. Energy* **14,** 157-166 (1973).

Key words: International Pyrheliometric Scale; irradiance; pyrheliometer; World Meteorological Organization.

The Third International Comparisons of Pyrheliometers organized by the World Meteorological Organization and the Davos Observatory were held in September 1970 at Davos and Locarno. For this purpose the intensity of solar radiation was measured simultaneously by the standard radiometers (Ångström compensation and silver-disc pyrheliometers) from all over the world. For meteorological use the intensity values refer to the International Pyrheliometric Scale 1956 represented by the reference instruments of the Davos Observatory and of the Swedish Meteorological and Hydrological Institute at Stockholm. At the same time measurements were performed by two instruments rendering an absolute value of high accuracy. These sophisticated instruments have been constructed by Kendall and Geist respectively.

A fully-automatic data acquisition system together with a computer was used to compare simultaneously the 22 Ångström Pyrheliometers and to monitor the auxiliary measurements necessary for defining the state of the atmospheric conditions specified by a turbidity coefficient of $0.03 < m\beta < 0.3$. The intensity values covered a range of 55-100 mW/cm$^2$. The results show a significant difference between the two radiometeric scales. The intensity value deduced from the absolute measurement is about 2 percent higher than the value based on the International Pyrheliometric Scale.

**13556.** Corliss, E. L. R., **Remark on "Fixed-scale mechanism of absolute pitch",** *J. Acoust. Soc. Amer. Letters to Editor* **53,** No. 6, 1737-1739 (June 1973).

Key words: Absolute pitch sense; audition; auditory memory; hearing; musical acoustics; pitch recognition.

Several aspects of this author's subjective experiences concerned with perception of pitch are at variance with the experiences reported by Paul T. Brady, *J. Acoust. Soc. Am.* **48,** 883-887 (1970). In particular, my recognition is not tied to a specific scale (though, of course, nomenclature must be); the precision of recognition shows little fluctuation, if any; and changes in tuning do not influence the recognition of pitch, although such changes may influence the performance of remembered music and the ease of transposition. Tonal memory overrides motor memory for the performance of music learned on instruments tuned to initially different keys.

**13557.** Kamper, R. A., Simmonds, M. B., Adair, R. T., Hoer, C. A., **Quantum mechanical measurement of rf attenuation,** *Proc. 1972 Applied Superconductivity Conf., Annapolis, Md., May 1-3, 1972,* pp. 696-700 (IEEE, Inc., New York, N.Y., 1972).

Key words: Josephson effect; quantum interference; rf attenuation; rf measurements; superconductivity.

We have used a broadband Superconducting QUantum Interference Device (SQUID), operating at a frequency of 9 GHz, as a sensor of current at lower radio frequencies. The periodic nature of the response of the SQUID enabled us to measure variations in rf attenuation directly. The results of such a measurement were in agreement with the NBS Calibration Service to within $\pm 0.004$ dB over a dynamic range of 40 dB. We also discuss other applications of this SQUID to rf measurements.

**13558.** Eisen, H., Rosenstein, M., Silverman, J., **Electron dosimetry using Chalkley-McLaughlin dye-cyanide thin films,** (Proc. Int. Symp. on Dosimetry in Agriculture, Industry, Biology and Medicine, Vienna, Austria, April 1972), Paper in *Dosimetry in Agriculture, Industry, Biology and Medicine,* pp. 615-625 (International Atomic Energy Agency, Vienna, Austria, 1973).

Key words: Calorimetry; depth dose; dose distributions; dye films; electron beams; interface; Monte Carlo transport; stopping power; thin films.

The purpose of this work was to measure electron energy deposition profiles in a variety of absorbing materials and to evaluate the Chalkley-McLaughlin radiochromic dye-cyanide film dosimeter. Information of this type is useful for effective utilization of electron beams in industry and medicine where adjustments in sample thickness, electron beam energy, angle of electron beam incidence, and backing materials may provide more advantageous beam utilization. Experimental depth-dose distributions were determined for broad beams of 2.00 MeV electrons incident on polystyrene, aluminium, copper, tin, gold, and several two-layer slab absorbers. Data were obtained for both semi-infinite and finite homogeneous absorbers at incident beam angles ranging from 0 (normal incidence) to 75 degrees. Radiochromic dye-cyanide films were used as solid-state cavity dosimeters, with an experimental reproducibility of $\pm 6\%$ ($2\sigma$). The stopping power ratio necessary to convert from film dose to absorber dose was evaluated several ways. Depth-dependent stopping power ratios, obtained by accounting for the changing electron energy spectrum with absorber depth by two methods, were compared with a constant stopping power ratio for each material. The difference between the constant ratio and a depth-dependent ratio was 1% to 2% for aluminium, 3% to 5% for copper, 3% to 7% for tin, and 3% to 8% for gold. The data demonstrate the decrease in the depth-dose distribution and the total absorbed dose in finite slabs as compared to equivalent layers in semi-infinite slabs. The effect of the atomic number of the absorber and the angle of beam incidence on the shape of the energy deposition profile is also demonstrated. The data for the two-component slab absorbers illustrate the modification of the depth-dose profile in a finite slab of material if a different material is placed adjacent to it. From the dose received by a film placed at the interface, the surface doses at that position were estimated using the material-to-film stopping-power ratio appropriate for each material. The data are compared to theoretical depth-dose profiles obtained using Monte Carlo transport codes.

The agreement is generally between 5% to 10% for homogeneous cases and in most cases better than 10% for the two-component cases.

**13559.** McLaughlin, W. L., Hjortenberg, P. E., Radak, B. B., **Absorbed-dose measurements with thin films,** (Proc. Int. Symp. on Dosimetry in Agriculture, Industry, Biology and Medicine, Vienna, Austria, April 1972), Paper in *Dosimetry in Agriculture, Industry, Biology and Medicine,* pp. 577-597 (International Atomic Energy Agency, Vienna, Austria, 1973).

Key words: Absorbed dose; calorimetry; cavity theory; depth dose; dosimetry; dye dosimeters; electron beams; gamma rays; plastic dosimeters; radiochromic dyes; thin films.

Thin films of plastic, coatings, papers, ceramics, emulsions, cleaved crystals, microtomed gel sections, and metal foils have all been used with advantage to measure large radiation absorbed doses. The three most successful methods of relating the radiation effects in the film to the dose are: Calorimetry, which measures temperature rise; photometry, which measures changes in light emission, transmission or reflection; and electrometry, which measures electrical changes such as variations in resistivity, e.m.f., current, etc. The chief problems in making good measurements of radiation dose or dose rate with thin films are: (1) quality control of the dosimeter itself; (2) discontinuity problems, that is, how the energy imparted to a thin probe is related to energy imparted to surrounding matter; (3) meaning of the calibration, that is, how the radiation effect in the film material is related to the absorbed energy as a function of spectrum dose rate, temperature, etc. The first of these can be dealt with effectively by control of film thickness, chemical composition and environmental influences. The second is often more complicated, especially if the thin probe differs appreciably in absolute density and atomic number from its surroundings, since proper application of cavity theory may be difficult for some geometrical arrangements. The third problem is usually the most difficult of all, because the radiation effect in a thin material used as a dosimeter often depends on many variables leading to systematic errors in dose interpretations. In this work, methods are given for calibrating in electron beams the radiation response of thin-film dosimeters calorimetrically, accounting for the sources of error cited above. The calibration procedures include the use of appropriate cavity-theory correction factors needed to relate the response of the thin probe of one material held in another medium. Finally, a suitable film dosimeter material is described. It consists of radiochromic dye films, which can measure doses from about $10^4$ to $10^8$ rad in various media under different irradiation conditions.

**13560.** Heinrich, K. F. J., **Errors in electron probe microanalysis,** *Proc. of the Seminar on Quantitative Analysis with Electron Microprobes and Secondary Ion Mass Spectrometry, Jülich, Germany, Oct. 18-20, 1972,* pp. 68-79 (Mar. 1973).

Key words: Data reduction; electron probe; errors; microanalysis; x-ray measurement.

Errors in quantitative electron probe microanalysis are due to errors in the measurement of relative characteristic x-ray intensities and in the interpretation of the experimental measurements. The random errors in the x-ray measurement include those due to Poisson's statistics, but other sources must not be excluded from consideration. Systematic errors may be committed in the estimation of coincidence losses (dead-time) and background. Those arising in the evaluation of the data may be due to the theoretical models, or to the parameters and constants which enter the calculation. Satisfactory models require adjustment to empirical measurements, and improvement in the accuracy of electron probe microanalysis requires the performing of critical experiments which can lead to further adjustment of the models. It is also important to adjust the conditions of measurement so as to minimize the effects of uncertainties and errors in models and parameters.

**13561.** Flynn, D. R., **Inter-Noise 72 Panel: Noise measurement—problems, perils and pitfalls,** *Noise/News* **2,** No. 1, 7-9 (Jan.-Feb. 1973).

Key words: Acoustics; noise measurements; sound levels.

This short paper discusses some of the problems involved in noise measurements. It is pointed out that noise measurement standards should specify environmental and operational constraints in addition to precise, accurate measurement and operational procedures. A few examples are given of sources of significant measurement errors. The Measurement Assurance Programs of NBS are briefly described as a means that has been used in other disciplines to improve measurements in a total system context.

**13562.** Moore, R. T., **Penetration tests on J-SIIDS barriers,** *NBSIR 73-223,* 86 pages, (June 4, 1973). (Available as COM 73-11120 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Barrier penetration; intrusion resistance; physical security.

A series of penetration tests were made on three simulated arms rooms which incorporated a variety of structural barriers which were intended to be representative of the broad range of construction likely to be encountered in existing arms rooms.

The observed penetration times varied from 1.3 minutes for a double-planked wooden wall, 11.31 minutes for an eight-inch thick, reinforced concrete wall and up to 18.27 minutes for a GSA Class 6 vault door. All penetrations were made with portable readily available tooling and produced acoustical or vibrational or both types of disturbances which are readily detectable.

The test results provide a basis for estimating the time in which response to an intrusion alarm must occur in order to adequately safeguard an arms room, a computer room or any other sensitive area.

**13563.** Garvin, D., **Chemical kinetics data survey V. Sixty-six contributed rate and photochemical data evaluations on ninety-four reactions,** *NBSIR 73-206,* 121 pages, (May 1973). (Available as COM 73-11262 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Atmospheric chemistry; chemical kinetics; data evaluation; gas phase reactions; optical absorption cross sections; photochemistry; quantum yields; rate constants.

This report records the data evaluations contributed to the Climatic Impact Assessment Program chemical kinetics survey during the period Nov. 1972-Apr. 1973 by various kineticists and photochemists. Data are included on reactions of $O(^1D)$, $O(^1S)$, $O_2(^1\Delta)$, $CH_3ONO$, $CH_3O$, $CH_3O_2$, $H_2O_2$, $HO_2$, SO, $SO_2$ and the $H_2$-$N_2$-$O_2$ system.

**13564.** Finkel, P. W., Rowen, J. W., **Clinical laboratory performance analysis using proficiency test statistics,** *NBSIR 73-197* Revised, 63 pages, (Dec. 1973). Supersedes PB213-287/6. (Available as COM 73-11253 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accuracy; CLIA '67; clinical chemistry; hematology; microbiology; precision; proficiency testing.

The proficiency testing aspects of the Clinical Laboratory Improvement Act of 1967 program were assessed. The overall

ability of licensed or volunteer laboratories to accurately determine mean values for any of the 13 constituents was not significantly altered during the first two years of program operation. However, the variability of the laboratories has decreased over the two-year period. It appears that the program has increased consistency of laboratory performance.

The general level of laboratory capability seemed to be independent of involvement in state-supported or voluntary proficiency testing programs other than the CDC program and of whether the working supervisor had a B.S., M.S., Ph.D., or M.D. degree. Choice of analytical method did significantly affect performance. Although insufficient evidence was available to make a definitive statement, the data do not appear to support arguments favoring establishment of method-dependent reference group target values.

Finally, it appears that consideration should be given to alternative sampling methods, such as reduced or skip-lot sampling, for those constituents which appear to present no analytical challenge to the licensed and volunteer laboratories. Greater emphasis might then be placed on those constituents which give the laboratories the most difficulty (cholesterol and creatinine, for example).

**13565.** Hust, J. G., Clark, A. F., **A survey of compatibility of materials with high pressure oxygen service,** *Cryogenics* **13,** No. 6, 325-336 (June 1973).

Key words: Compatibility data; high pressure; oxygen; safety; survey.

The literature on high pressure oxygen compatibility has been surveyed in order to present the existing state of knowledge. Searches have been conducted of NASA and NBS data retrieval systems. In addition, many individuals, active in the field, were contacted in order to retrieve useful unpublished information. Compatibility data, such as mechanical impact, pneumatic impact, ignition temperature, and flash-and-fire point, were compiled for pressures above 200 bar ($2 \times 10^7$ $Nm^{-2}$). Lower pressure data were included if they were useful for extrapolation to pressures above 200 bar. These data, too numerous to be given here, are available from the authors. Brief descriptions of the trends of these data are given. Recommendations for additional high pressure studies are included.

**13566.** McLaughlin, W. L., Bjergbakke, E., **Electrochemical dosimetry using ferric-fluoride ion complex formation,** (Proc. Int. Symp. on Dosimetry in Agriculture, Industry, Biology and Medicine, Vienna, Austria, Apr. 1972), Paper in *Dosimetry in Agriculture, Industry, Biology and Medicine,* pp. 383-396 (International Atomic Energy Agency, Vienna, Austria, 1973).

Key words: Dosimetry; electrochemistry; ferric-fluoride complex; ferrous sulfate solutions; fluorides; Fricke dosimeter; ion selective electrodes; lanthanum fluoride; potentiometry.

Irradiated aqueous ferrous sulphate solutions containing fluoride ions can be analysed for ferric ion yield by means of electrochemical potentiometry. For certain applications this approach has advantages over the usual method of spectrophotometric determination of ferric ion concentration, which also varies linearly with absorbed dose up to about 40 krad: (1) Small dosimeter volumes down to 10 microlitres are functional; (2) Solid gels may be used, thus allowing for thin-film geometries; (3) The potentiometric method permits real-time (current readings) or integrated (EMF readings) measurement of radiation dose. The electrochemical analysis of ion-complex yield is fairly simple. A fluoride ion electrode of the solid-state type serves as an ion-selective sensor. The electrochemical potential (or its rate of change in some instances) between the fluoride ion electrode and the reference electrode is then read on a pH-meter. Since the $Fe^{3+}$ cation complex with $F^-$ is not passed by the lanthanum fluoride crystal membrane at the end of the electrode probe, and since the free $F^-$ ion concentration diminishes linearly with dose up to about 40 krad (corresponding to approximately 0.4m*M* $Fe^{3+}$ ion concentration at pH 2.7), the dose or dose rate can be determined from readings of linear change in millivoltage or rate of change of millivoltage. For cobalt-60 gamma-ray irradiation of a 1.00m*M* solution of $Fe^{2+}$ and $F^-$ made to pH 2.7 with $H_2SO_4$, the G-value of $Fe^{3+}$ -$F^-$ complex formation is $13.7 \pm 0.3$ per 100 eV energy absorbed. This G-value is in good agreement with the initial G-value 13.75 of the Fricke dosimeter at pH 2.74.

**13567.** Hauge, R. H., Margrave, J. L., Hastie, J. W., **Infrared spectra of matrix isolated $ZrF_2$, $ZrF_3$, and $ZrF$,** *High Temp. Sci.* **5,** 89-96 (1973).

Key words: Entropy; geometry; infrared spectra; matrix isolation; stability; $ZrF_2$, $ZrF_3$, $ZrF_4$, $CaF_2$.

By using the multiple Knudsen cell technique the equilibrium species $ZrF_2$, $ZrF_3$, and $ZrF_4$ have been produced and isolated in rare gas solid matrices. From infrared spectra, the antisymmetric stretch frequencies have been assigned for each species. Isotope shift measurements indicate a $120° \pm 4°$ bond angle for the $C_{2v}$-$ZrF_2$ species, the symmetry being verified by the observation of the symmetric stretch frequency. The results are compared with those of the Ti-F and similar systems. The measured frequencies and bond angle of $ZrF_2$ were used to determine the entropy and FEF data for $ZrF_2$ at various temperatures.

**13568.** Hastie, J. W., **Mass spectrometric studies of flame inhibition: Analysis of antimony trihalides in flames,** *Combust. Flame* **21,** 49-54 (1973).

Key words: Antimony trihalides; flame inhibition; flames; mass spectrometry.

The chemistry of $SbBr_3$ and $SbCl_3$ in 1 atm premixed fuel rich $CH_4$-$O_2$ and $CH_4$-$O_2$-$N_2$ flames has been studied. Using line-of-sight mass spectrometric techniques, concentration profiles were obtained for the major species $SbX_3$, HX, $CH_3X$, X, Sb, and SbO, where X = Br or Cl. Reaction mechanisms are indicated and their relation to flame inhibition discussed. Evidence for a negligible perturbation of the flame kinetics by the sampling procedure is given.

**13569.** Mittag, K., **Kapitza conductance and thermal conductivity of copper niobium and aluminum in the range from 1.3 to 2.1 K,** *Cryogenics* **13,** No. 2, 94-99 (Feb. 1973).

Key words: Aluminum; copper; heat transfer; Kapitza conductance; niobium; superfluid helium; thermal conductivity.

The Kapitza conductance and thermal conductivity of ofhc-copper, niobium, ultra high purity aluminium, and of the aluminium alloy 6061 A1 have been measured in the temperature range from 1.3 to 2.1 K, yielding both quantities in the same steady state experiment. The temperature dependence of the Kapitza conductance, $h_0$, was between $T^{3.3}$ and $T^{4.6}$ for the different samples, which is higher than the most frequently observed $T^3$ dependence. The magnitude of $h_0$ for both ofhc-copper and aluminium agrees well at 1.9 K with an empirical prediction, but for niobium it is a factor of two to four lower than the value predicted. At 1.9 K, $h_0$ is higher by a factor of two for an annealed and chemically polished niobium sample than for an untreated sample. The thermal conductivity measured from ofhc-copper and 6061 A1 as in good agreement with the value calculated from the resistivity of these materials and the Wiedemann-Franz law. The measured thermal conductivity obtained for an an-

nealed niobium sample is a factor of 2.8 higher than the highest published value.

**13570.** Daney, D. E., McConnell, P. M., Strobridge, T. R., **Low-temperature nitrogen ejector performance,** (Proc. 1972 Cryogenic Engineering Conf., Boulder, Colo., Aug. 9-11, 1972), Paper L-4 in *Advances in Cryogenic Engineering* **18,** 476-485 (Plenum Press, New York, N.Y., 1973).

Key words: Cryogenic ejector; ejector; ejector pump; jet pump; low temperature refrigeration; refrigeration.

The primary objective of the test program reported here was to obtain a nitrogen ejector to replace the Joule-Thomson valve in a Joule-Thomson refrigerator. The desired primary nozzle inlet conditions were 200 atm and 161 K with a flow rate of 16.6 g/s, and the required entrainment ratio was 0.145. In an attempt to find a near optimum ejector for the above conditions, and in order to obtain a more general knowledge of low temperature nitrogen ejector performance, the tests were run over a range of operating conditions. The primary nozzle supply pressure ranged from 35 to 200 atm with a temperature near 161 K. The discharge pressure varied from 1.2 to 1.6 atm, and the entrainment ratio varied from 0.0 to 0.5. Combinations of three primary nozzles with three mixing sections resulted in a range of 118 to 365 for the ratio of the mixing tube area to the primary nozzle throat area. For the design conditions given above, a suction pressure of 0.27 atm was obtained. This corresponds to a liquid nitrogen saturation temperature of 67.7 K.

**13571.** Evans, J. P., **High temperature platinum resistance thermometry,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 2, 899-906 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Freezing point; gold point; high temperature; platinum resistance thermometer; standard thermocouple; temperature scale.

During the past decade a number of investigators have worked on various aspects of high temperature platinum resistance thermometry with the aim of developing thermometers suitable for use as interpolating instruments on a practical temperature scale up to the gold point. Long-time stability studies have been made of thermometers employing several designs and a variety of insulating and protecting materials; factors affecting the use of thermometers for temperature measurement have been investigated; new electrical instruments, using both direct and alternating current, have been developed to facilitate the measurement of thermometer resistance; and the investigation of metal freezing points as fixed points for calibrating thermometers has been extended to higher temperatures. An intercomparison of standard thermocouples and high temperature platinum resistance thermometers has shown that a practical temperature scale based on resistance thermometry can be realized at least an order of magnitude more precisely than a scale based on thermocouples, and several workers have suggested interpolation schemes for resistance thermometer scales. This paper reviews recent developments in high temperature platinum resistance thermometry, its current status, and some of the problem areas that need further attention.

**13572.** Powell, R. L., **Revision of the standard reference data for thermocouples,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 3, 1579-1584 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Standard Reference Data; thermocouples.

Revision of the International Practical Temperature Scale requires that there be changes for all accurately tabulated thermophysical values. Revised reference data for thermocouples have been generated in a cooperative program between groups of the National Bureau of Standards in Boulder and Gaithersburg. The new reference data reflect not only revisions in the temperature scale, but also slight changes in the materials themselves and improvements in data fitting methods. A new NBS monograph that contains tables, analytic expressions, various approximations, and explanatory text has been prepared. A general discussion of the project and some specific examples will be given.

**13573.** Cezairliyan, A., **Measuring transient high temperatures by optical pyrometry,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 657-664 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: High-speed measurements; high temperature; pyrometry; radiation; temperature measurement.

Various pyrometric (optical) methods, using photoelectric and photographic detectors, are described for measuring high temperatures. Emphasis is placed on techniques of measuring transient temperature of solids above approximately 1500 K with subsecond (upper millisecond to upper microsecond) resolution. Advantages and limitations of the various methods are discussed and estimates of uncertainties are given. Examples of application of the high-speed temperature measurement methods to various fields of investigations, including determination of thermophysical properties, is presented.

**13574.** Meijer, P. H. E., **Calculations on the specific heat and the susceptibility of interacting spin systems,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 1267-1278 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Dipole-dipole interactions; low temperature salts; specific heat; susceptibility.

The corrections on the specific heat and susceptibility due to dipole-dipole interactions in a number of low temperature compounds are calculated. A general description of the method is given, followed by a short discussion of the properties of the most used low temperature compounds. Eight representative salts were chosen and the deviations from the ideal specific heat and susceptibility in second and third order were determined.

**13575.** Cataland, G., Plumb, H. H., **The realization of low temperature fixed points on the NBS acoustical and the NBS-1955 temperature scales,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 183-193 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Acoustical thermometry; e-$H_2$ NBP-e-$H_2$ TP fixed points; neon NBP.

The normal boiling and triple points of equilibrium hydrogen have been realized and related to the NBS (1955) temperature

scale. From isotherms that were determined with the NBS acoustical thermometer, values of T(acoustical) can be associated with the above fixed points and also with the normal boiling point.

**13576.** Quinn, T. J., Lee, R. D., **Vacuum tungsten strip lamps with improved stability as radiance temperature standards,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4**, Part 1, 395-411 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Pyrometry; source; temperature; tungsten.

This paper describes the changes which take place in a piece of tungsten strip as it is outgassed and aged during the processing of a vacuum tungsten strip lamp. It is shown that by paying sufficient attention to the cleaning of the tungsten and the glass bulb, and to the outgassing and aging of the tungsten, a very stable strip lamp can be produced. Results are given of a series of stability tests from 1064 to 1500 °C of a group of lamps made in this way at NBS.

**13577.** Bedford, R. E., Ma, C. K., Barber, C. R., Chandler, T. R., Quinn, T. J., Burns, G. W., Scroger, M., **New reference tables for platinum 10% rhodium/platinum and platinum 13% rhodium/platinum thermocouples,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4**, Part 3, 1585-1602 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Blackbodies; calibrations; optical pyrometer; platinum resistance thermometer; platinum-rhodium vs platinum thermocouples; reference tables; thermometric fixed points.

New reference tables for platinum 10 percent rhodium/platinum and platinum 13 percent rhodium/platinum thermocouples have been prepared as a result of a cooperative program among the National Bureau of Standards (USA), the National Physical Laboratory (UK), and the National Research Council (Canada). High purity platinum wires ($\alpha \geq 1.3924 \times 10^{-3}$) and alloy wires of as closely as possible 10 percent and 13 percent rhodium composition, respectively, were supplied by seven American and British manufacturers, from which thirty-two Pt10Rh/Pt and thirty-six Pt13Rh/Pt thermocouples were constructed. Primary calibrations below 1064.43 °C were performed at NBS and NRC; primary calibrations above 1064.43 °C were done at NPL; thermocouple intercomparisons over the whole temperature range were done at NBS and NRC. The reference tables derive from polynomials fitted, by means of least squares orthogonal polynomial techniques, to a selected group of thermocouples of each type.

**13578.** Hudson, R. P., Pfeiffer, E. R., **Temperature scale for cerous magnesium nitrate,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4**, Part 2, 1279-1285 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Cerous magnesium nitrate; low temperature; magnetic temperature; temperature scale; thermometry.

Below 1 K, cerous magnesium nitrate (CMN) should obey the Curie Law over a wide temperature range and show deviations only in consequence of the dipolar coupling between ions. The susceptibility deviation should be accounted for by a very small Curie-Weiss $\theta$ (theoretical value, 0.27 mK) and the entropy should vary as $\ln 2 - AT^{-2} + BT^{-3} - CT^{-4} + \ldots$, with theoretical values now available for A, B and − somewhat less firmly based − C. These show that representation of S(T) by the term in A alone is justifiable only above 0.1 K. We present experimental values for A, B, and C arising from recent measurements together with new results for the magnetic temperature, T*, scale derived from γ-ray heating calorimetry.

**13579.** Anderson, R. L., **The high temperature stability of platinum resistance thermometers,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4**, Part 2, 927-934 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Chemical changes in platinum resistance thermometers; high temperature platinum resistance thermometers; physical changes in platinum resistance thermometers; stability of platinum resistance thermometers.

Some of the chemical and physical parameters that affect the stability of platinum resistance thermometers have been studied, particularly at temperatures near the gold point (1064 °C). A simplified form of resistance thermometer sensor was designed to aid in these studies. The new design, designated as the "steeple," allowed the fabrication of some thermometers from single crystals. Measurements were made of the resistance at the triple point of water after the thermometers had been held above 1000 °C for extended periods. Further information on the aging of platinum wires at high temperatures was obtained with the scanning electron microscope. Some of the results are shown to be applicable to standard thermometers when used above 400 °C.

**13580.** Powell, R. L., Hall, W. J., Hust, J. G., **The fitting of resistance thermometer data by orthogonal functions,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4**, Part 2, 1423-1431 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Numerical analysis; orthogonal functions; resistance thermometer.

Analyses of highly accurate thermal data require sophisticated fitting methods so that expensively obtained experimental precision will not be negated by inadequate mathematical techniques. This article describes fitting methods using orthogonal functions that have been used for several years to fit many types of data, including germanium resistance curves. The method is a generalization and extension of ideas suggested earlier by Lanczos for fitting noisy data. The method usually cleanly separates noise from the fundamental signal in a straightforward manner, allowing one to avoid either an oscillating overfit or an inaccurate underfit. The procedure consists of five parts: (1) transformation of variables so that the curve is as linear as possible in the transformed variables; (2) weighting of data to satisfy the Gauss-Markoff conditions with the weighting function inversely proportional to the experimental variance; (3) orthogonal function generation and coefficient determination using Gram-Schmidt type algorithms developed by Bjorck; (4) separation of noise coefficients from the fundamental signal coefficients based on their different dependence on the number of terms; and (5) calculation of smoothed data using the proper number of coefficients.

**13581.** Jacox, M. E., Milligan, D. E., **Matrix isolation study of the vacuum-ultraviolet photolysis of methanol. The infrared spectrum of the $CH_2OH$ free radical,** *J. Mol. Spectrosc.* **47,** No. 1, 148-162 (July 1973).

Key words: $CH_2OH$; force constants; infrared spectrum; matrix isolation; methanol; vacuum-ultraviolet photolysis.

Infrared studies of the products of the 1470 Å photolysis of normal and isotopically substituted methanol isolated in argon and nitrogen matrices at 14 K have provided evidence for the stabilization of a significant yield of $CH_2OH$. Assuming a slightly nonplanar structure for the molecule, it has been possible to obtain an approximate valence-force potential field which provides a reasonable fit to virtually all of the data. The C-O bond of $CH_2OH$ is slightly stronger than that of methanol, and the torsional barrier is significantly greater, in accord with previous electron spin resonance observations. There is no evidence for the production or stabilization of $CH_3O$ in the matrix. $CH_2OH$ undergoes photodecomposition upon exposure to radiation in the 2300-2800 Å spectral region, leading to a growth in the HCO absorptions.

**13582.** Liebman, J. F., **On the electron affinity of perfluorocycloalkanes and perfluoroalkanes,** *J. Fluorine Chem.* **3,** 27-33 (1973/74).

Key words: Electron affinity; fluorocarbons; orbital; perfluoroalkanes; perfluorocycloalkanes.

There is an increasing body of evidence showing that perfluorocycloalkanes have a higher electron affinity than their open chain analogs, the perfluoroalkanes. A new molecular orbital model is presented to explain these results and compared with the electrostatic model of Mittal and Libby. Explicit experiments are suggested which would allow comparison of the two models.

**13583.** Smith, R. L., Honda, T., **Impulse rise and fall times of biplanar vacuum photodiodes,** *Appl. Opt.* **12,** No. 7, 1606-1610 (July 1973).

Key words: Biplanar vacuum photodiodes; impulse fall time; impulse rise time; laser pulses.

The impulse rise and fall times of biplanar vacuum photodiodes are experimentally investigated by the use of a single ultrashort laser pulse from a train of mode-locked pulses. It was confirmed that the impulse rise time is a function of the photoelectrons' transit time from photocathode to anode, and that the impulse fall time is 2.2 times the capacitance of the photodiode and the resistive component of the load.

**13584.** Reader, J., **Comment on: How to mount a Pellin-Broca prism for laser work,** *Appl. Opt.* **12,** No. 7, 1405 (July 1973).

Key words: Pellin-Broca prism; spectroscope.

It is shown that a recently published mounting for constant deviation prisms is equivalent to one published in 1917. An example of the use of this mounting for a plane grating spectrograph at NBS is given.

**13585.** Burns, G. W., Hurst, W. S., **Studies of the performance of W-RE type thermocouples,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 3, 1751-1766 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Beryllium oxide; ductility; emf-temperature relationship; microstructure; thermocouple drift; W-Re alloys; W-Re type thermocouples; W-Re thermoelements.

The effect of exposure of bare-wire and BeO-insulated commercial W-Re thermocouple materials to high temperatures in gaseous environments has been investigated. The temperature range of interest has been primarily 2000 to 2400 K, and the investigations have been confined to thermocouple wires of 0.25 mm diameter. With high temperature exposure of the bare thermoelements, an initial shift in the emf-temperature relationship of the exposed thermoelements versus an unexposed "as received" thermoelement was exhibited, and thereafter no discernible drift occurred with exposure in environments of Ar, He, $H_2$ or $N_2$ for periods up to 1000 hours. Aging studies were performed to determine the time-temperature parameters of the shift. Thermoelements were examined for metallurgical structural changes and chemical changes by conventional methods. In the temperature range of interest, grain growth was inhibited in the chemically doped W-3 percent Re alloy, and excellent room temperature ductility was retained subsequent to the exposure. The compatibility of high purity (in excess of 99.8 percent), sintered BeO insulators with the thermoelements differed, depending upon whether the BeO-insulated thermoelement assemblies were self-heated electrically or heated in a furnace; in tests in argon environments, highly reliable performance occurred when the assemblies were heated in a furnace. BeO-insulated W-3 percent Re vs W-25 percent Re thermocouples, constructed with degassed and aged materials, exhibited drifts equivalent to about 3 mK/h during 1000 hours of exposure at 2073 K in argon while in the presence of tantalum.

**13586.** Furukawa, G. T., Bigge, W. R., Riddle, J. L., **Triple point of argon,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1C, 231-243 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Argon; fixed point; triple point; temperature scale.

The average triple-point (TP) temperature of two argon cells was determined to be $83.7997_7$K, the two cells being within 0.38 mK of each other and the estimated uncertainty of the value being $\pm 0.5$ mK. (The uncertainty includes imprecision of the measurements and possible systematic errors.) The temperature value is based on thermometers calibrated in terms of the NBS-1955 temperature scale adjusted to the International Practical Temperature Scale of 1968 (IPTS-68). The value of temperature obtained by extrapolating the deviation function, $\Delta W_r(T)$, specified for the temperature interval 90.188 K to 273.15 K by the IPTS-68, is about 0.3 mK lower. The argon TP is recommended as a defining fixed point to replace the oxygen normal boiling point.

**13587.** Kamper, R. A., **Survey of noise thermometry,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 349-354 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Absolute temperature; thermal noise; thermometry.

This survey covers various techniques which have been developed to estimate relative or absolute temperatures by measuring various parts of the spectrum of thermal noise at frequencies in the microwave range and below. It includes a report of the author's own work on absolute noise thermometry in the millikelvin range of temperature.

**13588.** Guildner, L. A., Anderson, R. L., Edsinger, R. E., **Effects of sorption on the realization of the thermodynamic scale,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1E, 313-322 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Gas thermometer; sorption; steam point; thermodynamic temperature scale.

The NBS Gas Thermometer is of the constant volume type. It has a 450 $cm^3$ platinum-20% rhodium bulb connected by a 0.9 mm internal diameter tube to a diaphragm at room temperature. The measured quantities contribute an estimated uncertainty of 5 parts per million. The gas thermometer has such stability that, upon return to the fiducial temperature, the pressure is reproduced within one or two parts per million for periods of a week or more. This stability is attributed to a marked reduction of sorption effects achieved by the following: (1) The thermometer bulb is subjected to prolonged pumping at high temperatures prior to measurements. (2) With most of the contaminants removed by this procedure, and the use of very pure helium as a thermometric fluid, there is too little active gas left to produce erratic results from sorption. The value of the temperature at the steam point on the thermodynamic Celsius scale has been determined as 99.973 °C. A final certainty is not assigned.

**13589.** Gonano, R., **Isothermal comparisons of $He^3$ and $He^4$ vapor pressures,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 121-126 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Helium; pressure measurement; temperature scale; vapor pressure.

Isothermal measurements of $He^3$ and $He^4$ vapor pressures are being made in order to compare proposed vapor pressure scales in the region 0.90 to 3.32 K. Preliminary results in the range 1.40 to 3.25 K show that the currently accepted scales, $T_{62}$ and $T_{58}$, are in close agreement with each other as was intended during the construction of $T_{62}$. Observed differences are less than 0.6 mK (rms deviation = 0.22 mK), which is within the experimental uncertainty of the present comparison. No systematic pattern is detectable in the deviations. A comparison of germanium resistance thermometers calibrated on the NBS Provisional Scale 2-20 (1965) with the vapor pressure scales shows that $T_{2\text{-}20} - T_{vp}$ ranges from 6 mK at 2.3 K to 10 mK at 4.2 K, in agreement with other published values. We also discuss the techniques used to reduce or eliminate the effects on vapor pressure measurements of the aerostatic and thermomolecular pressure gradients and of the heat load due to superfluid film flow.

**13590.** Lee, R. D., Kostkowski, H. J., Quinn, T. J., Chandler, P. R., Jones, T. P., Tapping, J., Kunz, H., **Intercomparison of the IPTS 68 above 1064 °C by four national laboratories,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 377-393 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: International temperature scale; pyrometry; standards; temperature.

The International Practical Temperature Scale above the melting point of gold, as realized and maintained with high precision photoelectric pyrometers at NBS, NPL, NSL and PTB, has been intercompared. Six specially selected tungsten strip lamps, four vacuum and two gas, were used in the intercomparison. Determinations were made at a number of brightness temperatures from 1064 to 1700 °C and at 2200 °C with the laboratories agreeing to within a few tenths of a degree up to 1700 °C and 2.0 °C at 2200 °C.

**13591.** Schooley, J. F., Soulen, R. J., Jr., **The use of superconductors to provide fixed points on a cryogenic temperature scale,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 169-174 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Fixed points; OSRM; superconductive devices; superconductive transition temperature; superconductivity; temperature scale.

It is suggested that reproducible superconductive transition temperatures be used as fixed points for temperature scales below 10K. The superconductive transitions of lead, indium, aluminum, zinc, and cadmium have been found to be as narrow as one millikelvin and reproducible to less than one millikelvin. It is planned that devices incorporating these elements will be made available through the NBS Office of Standard Reference Materials.

**13592.** Ginnings, D. C., Reilly, M. L., **Calorimetric measurement of thermodynamic temperatures above 0 °C using total blackbody radiation,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1, 339-348 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Blackbody; calorimeter; ice point; steam point; Stefan-Boltzmann law; thermodynamic temperature scale.

Using the Stefan-Boltzmann law, a thermodynamic temperature can be determined by measuring the ratio of blackbody radiation at the unknown temperature to that at the triple point of water. This measurement requires no knowledge either of radiation constants or of geometry. For the above measurements, there has been developed a heat-flow calorimeter operating at liquid helium temperatures in which extremely small powers can be accurately measured. The radiant power absorbed by the calorimeter is measured by substituting known electrical power; if these powers are equal the substitution results in no change in the temperature of the calorimeter.

The calorimeter was originally intended for measuring the thermodynamic temperature of the melting point of gold, but as a check on its performance, measurements are being made of the ratio of radiation at 100 °C to that of 0 °C (IPTS-68). Performance tests show the calorimeter to be sensitive to a change of about 0.002 °C in the temperature of the radiator with the chosen aperture system. There is now in progress an investigation of possible errors of the measurements, including any effect of diffraction.

**13593.** Ely, J. F., Hanley, H. J. M., Straty, G. C., **Analysis of the pressure virials and Clausius-Mossotti function for polyatomic gases,** *J. Chem. Phys.* **59,** No. 2, 842-848 (July 15, 1973).

Key words: Clausius-Mossotti function; dielectric virial coefficients; m-6-8 potential; polarizability; polyatomic gases; pressure second virial coefficients; quadrupole moment; statistical mechanics.

Statistical mechanical equations for the second pressure virial coefficient and the second and third dielectric virial coefficients for quadrupolar molecules are evaluated using the *m*-6-8 potential function. The results are compared with experimental data for nitrogen and fluorine. An approximate value for the quadrupole moment of fluorine is estimated. Agreement between theory and experiment is generally good.

13594. Sugar, J., **Ionization energies of the neutral actinides,** *J. Chem. Phys.* **59,** No. 2, 788-791 (July 15, 1973).

Key words: Actinium; americium; berkelium; californium; curium; einsteinium; fermium; ionization energy; mendelevium; neptunium; nobelium; plutonium; protactinium; thorium; uranium.

Values for the ionization energies of the neutral actinides have been derived by utilizing interpolated spectral properties of these atoms. The results in electron volts are Ac: 5.17(12); Th: 6.08(12); Pa: 5.89(12); U: 6.05(7); Np: 6.20(12); Pu: 6.06(2); Am: 5.993(10); Cm: 6.09(2); Bk: 6.30(9); Cf: 6.41(10); Es: 6.52(10); Fm: 6.64(11); Md: 6.74(12); No: 6.84(12).

13595. Brown, W. C., Buchanan, C. J., **A study of the strength capabilities of children ages two through six,** *NBSIR 73-156,* 56 pages, (Aug. 7, 1973). (Available as COM 73-11286 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Children; children's strength; pull; push; safety; strength; squeeze; test methods; toys; toy safety; twist.

The Child Strength Study was conducted to provide information which can be used to develop reliable and realistic standards and test methods for children's toys. The study was conducted on over 550 children in the Washington Metropolitan area, and included both black and white children with varying economic and social backgrounds.

Four test devices were used to measure the forces exerted by children when pushing, pulling, twisting, and squeezing. Quantitative relationships were found to exist between these four types of measurements. The study also provided quantitatively precise and useful information about the effects of age and sex on the strength capability of children two through six years old. The results of the study are exhibited in tables of averages, standard deviations, coefficients of variation, and 95th percentiles for each age and sex group tested. A number of graphs are also included for a quick appraisal of the test results.

13596. Craw, A. R., **Analyses for decision in the office of flammable fabrics: the level of the standard,** *NBSIR 73-182,* 90 pages, (Apr. 1973). (Available as COM 73-11284 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Children's sleepwear; decision analysis; flammable fabrics; probability assessment; standards; utility theory.

The fundamentals of a single-stage decision problem are discussed and illustrated in the problem: The Level of the Standard for Children's Sleepwear, originally discussed by M. Tribus. Outcomes are identified, and various potential measures of disutility are discussed.

Given a particular alternative is in effect one must assign the conditional probabilities of arriving at each outcome. This process is aided by introducing intermediate events (extending the conversation). For the children's sleepwear problem this is done by considering for each of two age groups and three income levels the probability tree with branches: alternatives (a), technology (T), nightwear (N), additional cost to the consumer (C), Use (U) or non-use (u), existence of a hazard (H), exposure (E), ignition (I), burn (B) and burn-severity ($B_i$), survival (S) or death (D) and body image ($I_d$).

Attention is given to the preliminary assignment of each of the conditional probabilities needed. Suggestions are made as to sources of information. Much of the needed information is not available, especially that dealing with the social and behavioral aspects of the problem. The concept of exposure to an ignition hazard, for which an operational definition does not exist, is discussed.

13597. Garvin, D., **Chemical kinetics data survey IV. Preliminary tables of chemical data for modelling of the stratosphere,** *NBSIR-203,* 95 pages, (May 1973). (Available as COM 73-11288 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Atmospheric chemistry; chemical kinetics; data evaluation; energy transfer; gas phase; high temperature air chemistry; ion-molecule reactions; optical absorption cross sections; photochemistry; quantum yield; rate constants.

Chemical kinetic and photochemical data for gas phase reactions pertinent to the chemistry of the stratosphere are presented in four tables. These tables give recommended values and also cite recent experimental work. They give data in the following subject areas: chemical reactions and photochemistry of neutral species, energy transfer reactions, high temperature air reactions, and ion-molecule reactions.

13598. McClenon, R., **General purpose scientific document code operations under Exec 8,** *NBSIR 73-198,* 21 pages, (May 1973). (Available as COM73-11289 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Character codes for scientific text; computerized text processing; NBS computer system; scientific text; users manual.

Operating procedures for the use of the General Purpose Scientific Document Code text handling system are described. These apply to the use of the system on the NBS 1108 computer under control of the Exec 8 supervisor. Control cards, file definition and handling, compilation of routines and execution of programs are described. Examples of typical runs are given. The report is a manual for users of the system.

13599. Furukawa, G. T., Riddle, J. L., Bigge, W. R., **Investigation of freezing temperatures of National Bureau of Standards tin standards,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1D, 247-263 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Fixed point; freezing point; standards; tin; tin point.

The intercomparison of freezing points was made on selected samples of tin from two series of standards that are nominally 99.9999 (6N) and 99.999 (5N) percent pure. The freezing point of each tin-point cell prepared from the samples is reproducible within 0.05 mK from freeze to freeze; the freezing points of the cells from each series agree with each other within ±0.1 mK. The freezing points of the 5N standard are on the average 0.5 mK lower than those of the 6N standard. On the basis of the chemical purity information on the samples, the freezing-point of the 6N samples is expected to be within less than ±0.7 mK of the freezing point of 100 percent pure tin.

**13600.** Fraker, A. C., Ruff, A. W., Yeager, M. P., **Corrosion of titanium alloys in physiological solutions,** (Proc. 2nd Int. Conf. on Titanium, Boston, Mass., May 2-5, 1972), Paper in *Titanium Science and Technology,* R. I. Jaffee and H. M. Burte, Eds., **4,** 2447-2457 (Plenum Publishing Corp., New York, N.Y., 1973).

Key words: Alloys; biological; corrosion; electron microscopy; implant; saline solution; titanium.

This study intends to determine corrosive effects of saline and organic solutions on several titanium alloys for potential use as biological implant materials. Experimental techniques included electrochemical measurements and thin foil transmission electron microscopy and diffraction. The effects of varying alloy composition, method of specimen preparation, and different organic and salt solutions were studied. Thin foil transmission electron microscopy was used to examine surfaces of specimens exposed to salt solutions containing albumin, cystine, alanine and uric acid.

**13601.** Furukawa, G. T., **Vapor pressures of $^{20}$Ne and $^{22}$Ne,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 1B, 127-135 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Fixed point; $^{nat}$Ne; $^{20}$Ne; $^{22}$Ne; neon; vapor pressure.

The results of the vapor-pressure measurements with pure neon isotopes $^{20}$Ne and $^{22}$Ne are described. The measurement precision is $\pm 0.1$ to $\pm 0.2$mK. The vapor pressures of $^{nat}$Ne calculated from the law for ideal solutions and the data on the pure neon isotopes are in agreement with the observed values on $^{nat}$Ne within about $\pm 0.5$ mK. A table of normal boiling point temperature as a function of composition of "$^{nat}$Ne" is given.

**13602.** Fraker, A. C., Ruff, A. W., **The effect of solution pH on the saline water corrosion of titanium alloys,** (Proc. 2nd Int. Conf. on Titanium, Boston, Mass., May 2-5, 1972), Paper in *Titanium Science and Technology,* R. I. Jaffee and H. M. Burte, Eds., **4,** 2655-2663 (Plenum Publishing Corp., New York, N.Y., 1973).

Key words: Corrosion; electron microscopy; pressure; salt water; titanium.

The initial stages of corrosion attack on several titanium alloys in saline water solutions have been studied. Transmission electron microscopy and electron diffraction were used to study the corrosion films formed on the exposed surfaces of thin foil specimens and to determine their degree of crystallinity and composition. The corrosion sensitivity of each material to pH variation was studied. Six different alloys were examined over the range 100-200 °C in a Hastelloy-C pressure vessel containing the 3.5 wt. pct. NaCl solution. Sulfuric acid, hydrochloric acid and sodium hydroxide were added singly to the saline solution for individual tests with pH values ranging from 1.8 to 12.5. We find that the surface oxide composition changes with different solution pH values. The oxide covering the surface after exposing in neutral and acid solutions does not occur in alkaline solutions. Examples of local pitting attack were found to occur at both high and low pH values but were more frequent when specimens were corroded in the alkaline solutions.

**13603.** Hust, J. G., Powell, R. L., Sparks, L. L., **Methods for cryogenic thermocouple thermometry,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 3, 1525-1535 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Cryogenics; thermocouples; thermometry.

Accurate cryogenic thermocouple thermometry is only possible if care is taken in material selection, general experimental design, thermocouple calibration and assembly, and measurement techniques. After several years' research on both calibration and usage of thermocouples, we have developed procedures and tests that minimize experimental temperature errors and give realistic estimates of the inaccuracies.

Some material selection criteria are listed and recommendations are given for a few common experimental conditions. Simple experimental systems are described that may be used for tests to determine static or dynamic short range inhomogeneities, variability and interchangeability of different lots, and deviations from standard values. Methods for adding corrections to the standard tables are also given.

Good design criteria and methods of thermocouple assembly can lead to significant improvement in accuracies. Specific topics of discussion include reference junction placement, thermal tempering, heat conduction and radiation shielding, electrical connections, and electrical shielding.

**13604.** LaVilla, R. E., **$M_{2,3}$-Region x-ray emission spectrum from gaseous krypton,** *Phys. Rev. A* **8,** No. 2, 1143-1145 (Aug. 1973).

Key words: Double electron single vacancy process; final state configuration interaction; krypton; $M_{2,3}$ x-ray emission; single electron double vacancy process.

The $M_{2,3}$ x-ray emission spectrum of gaseous krypton excited by direct electron bombardment has been recorded with a scanning single-flat crystal spectrometer. The most prominent spectral features are two peaks at 187 and 203 eV, with the 187-eV peak having an extended low-energy tail. This low-energy tail is attributed to double-electron single-vacancy transitions owing to the strong mixing of the final-state configuration $4s4p^6\,{}^2S$ with the even levels $4s^24p^4ns\,{}^2S$ and $4s^24p^4nd\,{}^2S$. The 203-eV peak is identified as probably the single-electron double-vacancy $M_{2,3}M_{2,3} \rightarrow M_{2,3}N_1$ multiplet complex.

**13605.** Kuriyama, M., **Dynamical diffraction equations for imperfect crystals,** *Z. Naturforsch.* **28a,** No. 5, 622-626 (1973).

Key words: Canonical transformation; dynamical diffraction; imperfect crystal.

The ray theory of Kato and Kambe for imperfect crystals is derived in a formal way from a general dynamical theory of diffraction. This development together with the results from a previous paper concerning Takagi's equation (the wave theory) helps to clarify the meaning and limits of various phenomenological theories that have been extended to an imperfect crystal from the dynamical diffraction theory for a perfect crystal.

**13606.** Fromhold, A. T., Jr., Kruger, J., **Space-charge and concentration-gradient effects on anodic oxide film formation,** *J. Electrochem. Soc.* **120,** No. 6, 722-729 (June 1973).

Key words: Anodization; corrosion; oxidation.

Numerical computations illustrate the effects of space charge and a concentration gradient on the steady-state mobile-defect concentration profile and the kinetics of anodic film formation. The position-dependence of the concentration of mobile defects producing growth is shown to vary with current density and film thickness. Of especial interest is a series of curves illustrating the total electrostatic potential developed across the oxide as a function of thickness for growth under constant current conditions.

Space charge is shown to have the capability of being a critical factor in retarding the growth rate of the anodic film.

**13607.** Mitchell, R. A., Woolley, R. M., Chwirut, D. J., **Composite-overlay reinforcement of cutouts and cracks in metal sheet,** *NBSIR 73-201,* 96 pages, (Feb. 1973). (Available as COM73-11121 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Adhesively bonded joints; composite materials; composite-overlay reinforcement; contour plotting; cracks, reinforcement of; cutouts, reinforcement of; debond analysis, progressive; finite element analysis; joints, adhesively bonded; nonlinear analysis, shear; reinforcement, composite overlay; reinforcement, cutouts and cracks; shear analysis, nonlinear.

Finite element computer programs were developed for the planform analysis and the longitudinal cross-section analysis of metal sheet reinforced by adhesively bonded overlays of composite material. The analyses articulate the separate responses of the metal sheet, the composite overlays, and the adhesive layers. All materials are assumed to be orthotropic and linear elastic, with the provision that nonlinear interlaminar shear deformation can be approximated by a series of stepwise-linear solutions. The computer programs were developed specifically for the study of three general configurations: (1) a sheet with a reinforced cutout; (2) a sheet with a reinforced cutout with two symmetrical transverse cracks, within the sheet, radiating away from the cutout edge; and (3) a sheet with a reinforced transverse crack. The programs are also suitable for the study of bonded lap joints. The principal output of the computer programs is a set of contour plots of stress and strain fields throughout the sheet, the overlays, and the adhesive layers. A series of laboratory tests was conducted to demonstrate the validity of the analyses. Strains measured on the surfaces of specimens representing the general configurations studied were, for the most part, in good agreement with strains predicted by the finite element analyses. Significant correlations between certain failure modes and the stresses computed by the finite element analyses were apparent. Similarities between the modes of failure under static and fatigue loading were also evident.

**13608.** Peiser, H. S., Coyle, T. D., Eby, R. K., **A report on a survey in Korea on standardization and measurement services in support of industrialization goals of Korea.** *NBSIR 73-185,* 41 pages, (June 19-30, 1972).

Key words: AID; assistance; economics; LDC's (less developed countries); measurement services; standardization; survey; Korea.

The survey of standardization and measurement services for developing industries in Korea has been carried out by NBS with funding by AID, participation by representatives of Ecuador and Turkey, and under the guidance of the Korean Ministers for Commerce and Industry, and for Science and Technology. The Korean Director of the Survey was backed by six Korean Survey Team members and seven senior staff. The Survey Team spent two weeks in Korea where it inspected representative laboratories and plants, and had discussions with leaders of government, the USAID Mission, principal universities and industry. The report describes the preparation for the Survey, a summary of the economy of the country, notes on Korean science and technology, and relevant Korean institutions and laws. Nineteen problems were identified as of concern to national capability for standardization and measurement services. A summary description is given of the various existing and needed functions that Korean government should provide. The idea is endorsed to create a single agency to address all these functions.

**13609.** Ferguson, J. B., **Summary of flame spread and smoke generation tests conducted for Operation BREAKTHROUGH,** *NBSIR 73-228,* 27 pages, (July 1973). (Available as PB 222425 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Carpets; flame spread; kitchen cabinets; Operation BREAKTHROUGH; smoke generation; wall and ceiling.

This document is a listing of the flame spread and smoke generation results of a range of materials that were tested under the Operation BREAKTHROUGH housing evaluation program. The test results reported here were obtained under differing conditions and should not be considered the results of a comprehensive and unified research program for evaluation of interior finish materials. Tables of test results and a brief discussion of the results are presented for walls, ceilings, kitchen cabinets and floor coverings.

**13610.** Siu, C. I., Ellis, W. M., Kusuda, T., **Test of a polyester composite wall panel for moisture accumulation and potential removal of moisture through venting,** *NBSIR 73-220,* 18 pages (May 1973). (Available as PB 222437 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Composite wall panel; condensation; humidity; moisture; pressure; temperature.

A polyester composite exterior wall panel was exposed to accelerated winter temperature and humidity conditions for the purpose of determining performance with respect to moisture accumulation and release as a result of pressure and temperature differences. No moisture condensation within the wall system was detected from visual examinations made at various times of the testing period; no significant increase in gross weight of the wall was found from the direct weighings of the wall system. Results also indicate that a wet insulation in such a wall system is unlikely to be dried out by natural thermal action and convective motion.

**13611.** Rupp, N. W., **Intermediary base and cementation,** Chapter 5 in *Operative Dentistry,* L. Baum, Ed., pp. 59-72 (W. B. Saunders Co., Philadelphia, Pa., 1973).

Key words: Cementation; intermediary base; pulp protection; retention; temporary cementation.

This is a literature review of the dental cements currently being used for intermediary bases and cementation. Clinical applications of the various cements are discussed relative to physical properties and biological response of tooth tissues. Some recently introduced materials are included.

**13612.** Craw, A. R., Ku, R., **The sensitivity of certain indices associated with two-vehicle accidents,** *Accident Anal. Prev.* **5,** 137-146 (1973).

Key words: Highway traffic accidents; indices; sensitivity analysis.

This study describes in mathematical terms a procedure employed by the National Highway Traffic Safety Administration of the Department of Transportation for the analysis of two-vehicle accidents. The procedure contains an Assignment Rule in which one of the involved driver-vehicle combinations is assigned to the class of active involvement and the other driver-vehicle combination is assigned to the class of passive involvement. One case of interest is the Random Assignment Rule, and this is contrasted with the results of a Fixed Assignment Rule.

Results are derived that show the effect on specific indices of (1) errors in assignment and (2) a Composite Assignment Rule (a mixture of Fixed and Random Rules).

**13613.** Birky, M. M., **Calorimeter for laser energy measurements,** *Appl. Opt.* **10,** No. 1, 132-135 (Jan. 1971).

Key words: Calorimeter; energy; laser; neodymium; ruby.

A calorimeter enclosed in a constant temperature environment has been constructed to measure the output energy of a conventional mode ruby or neodymium laser. The calorimeter was designed according to the measurement theory and has an estimated uncertainty of ± 2% in the range 5J to 100J. The time-temperature curves were analyzed according to the theory with the aid of a computer program.

**13614.** Waterstrat, R. M., Manuszewski, R. C., **The chromium-rhodium constitution diagram,** *J. Less-Common Metals* **32,** 331-343 (1973).

Key words: Chromium alloys; constitution diagram; equilibrium diagram; phase diagram; rhodium alloys.

The Cr-Rh alloy system has been studied over the entire composition range by metallography, X-ray diffraction and electron microprobe methods. There are two intermediate phases in this system. The $\epsilon$ phase has a hexagonal close-packed structure and is stable over a broad composition range from about 20 at.% Cr at 900 °C to 68 at.% Cr at 1475 °C. The $\beta$ phase possesses a $Cr_3Si(A15)$ type structure and is stable over a narrow composition range from about 77 to 78 at.% Cr. The location of the face-centered cubic ($\gamma$ Rh) to hexagonal close-packed ($\epsilon$ phase) transition is strongly temperature dependent. Precipitation of a metastable hexagonal close-packed structure occurs during rapid cooling of the body-centered cubic ($\alpha$-Cr) solid solution. A peritectic reaction exists at 1700 ± 10 °C, a eutectic reaction occurs at 1475 ± 10 °C, and peritectoid reaction is located at 1265 ± 12 °C.

**13615.** Cezairliyan, A., **Measurement of the heat capacity of graphite in the range 1500 to 3000 K by a pulse heating method,** (Proc. 6th Symp. on Thermophysical Properties, Palm Springs, Calif., Aug. 1973), Paper in *Proceedings of the 6th Symposium on Thermophysical Properties,* P. E. Liley, Ed., pp. 279-285 (American Society of Mechanical Engineers, New York, N.Y., 1973).

Key words: Graphite; heat capacity; high-speed measurements; specific heat; thermodynamics.

Measurement of the heat capacity of a grade of graphite (AXM-5Q, POCO) in the temperature range 1500 to 3000 K by a subsecond-duration, pulse-heating technique is described. The smoothed results for a single specimen corresponding to two different heating rates are in agreement within 0.1% on the average. The smoothed results for two different specimens are in agreement within 0.6%. The heat capacity of graphite in the temperature range 1500 to 3000 K based on the present results is expressed by the following function (standard deviation = 0.5%):

$$c_p = 19.12 + 4.236 \times 10^{-3} T - 5.919 \times 10^{-7} T^2,$$

where T is in K and $c_p$ is in J $mol^{-1}K^{-1}$. The inaccuracy of the reported results is estimated to be not more than 3%.

**13616.** Barnes, I. L., Murphy, T. J., Gramlich, J. W., Shields, W. R., **Lead separation by anodic deposition and isotope ratio mass spectrometry of microgram and smaller samples,** *Anal. Chem.* **45,** No. 11, 1881-1884 (Sept. 1973).

Key words: Anodic deposition; isotopic analysis; lead; mass spectrometry.

A method is reported for the separation by anodic deposition and subsequent analyses by isotope ratio mass spectrometry of small samples of lead from a variety of matrices. The combined procedure is applicable to samples containing from 10 $\mu$g to less than 10 ng of lead and the electrodeposition is more than 95% efficient at these levels. Only a few elements interfere with the deposition, most notably iron and cerium, and procedures for removing the interfering elements are given. The optimum conditions for the anodic deposition of lead as $PbO_2$ were studied. The mass spectrometric procedure described permits a precision of 0.1% (95% limit of error) or better for the measured isotopic ratios.

**13617.** Hartman, A. W., Rosberry, F. W., Simpson, J. A., **A non-contacting length comparator with 10 nanometer precision,** *Opt. Eng.* **12,** No. 3, 95-101 (May/June 1973).

Key words: Dimensional metrology; displacement measurement; microscope; non-contact sensing; optical surface probe; surface detection.

A non-contacting length comparator utilizing two specially designed photo-electric microscopes has been constructed. Performance tests of this comparator, using lapped and polished steel surfaces demonstrate a resolution of ~ 1 nanometer, a precision of ~ 10 nanometers, and a linear range in excess of 50 micrometers.

**13618.** Creswell, R. A., Lafferty, W. J., **Microwave spectrum, dipole moment, and conformation of 3,6-dioxabicyclo[3.1.0] hexane,** *J. Mol. Spectrosc.* **46,** No. 3, 371-380 (June 1973).

Key words: Boat conformation; dipole moment; microwave spectrum; ring conformation; rotational constants; 3,6-dioxabicyclo[3.1.0]hexane.

The microwave spectrum of 3,6-dioxabicyclo[3.1.0]hexane has been obtained. The rotational lines of one ring conformation only have been observed and assigned. Ground state rotational constants are $A_0 = 6287.302 \pm 0.011$ MHa, $B_0 = 4683.546 \pm 0.008$ MHz, and $C_0 = 3358.517 \pm 0.089$ MHz. The dipole moment components obtained from Stark effect measurements are $\mu_a = 0.276 \pm 0.010$ D and $\mu_c = 2.47 \pm 0.04$ giving $\mu = 2.485 \pm 0.040$ for the dipole moment of the molecule. The rotational constants and dipole moment components obtained experimentally can be satisfactorily explained only if the boat form is the most stable ring conformation.

**13619.** Olson, W. B., **A precision photoelectric azimuthal polarimeter,** *Opt. Eng.* **12,** No. 3, 102-105 (May/June 1973).

Key words: Instrument; polarimeter; polarimetry quartz; signal-to-noise ratio; throughput.

A high precision photoelectric azimuthal polarimeter has been designed and constructed. The instrument is designed to determine the angle of rotation with an accuracy ($3\sigma$) of better than 1 part in $10^4$. The instrument is of a relatively compact design and quite simple in construction.

**13620.** Bowen, R. L., Chandler, H. H., **Metal-filled resin composites,** *J. Dental Res.* **52,** No. 3, 522-532 (May-June 1973).

Key words: Aluminum; composites; coupling agents gold; mercaptan; methacrylates; polymers; resin; silane; tantalum; zirconium.

Certain physical properties of metal-filled resin composite materials can be improved if properly selected and applied coupling agents are used in treating the surfaces of the metal particles.

**13621.** Waterstrat, R. M., **The chromium-platinum constitution diagram,** *Met. Trans.* **4,** 1585-1592 (June 1973).

Key words: Alloys; chromium; constitution diagram; equilibrium diagram; phase diagram; platinum.

The system Cr-Pt has been investigated over the entire composition range by metallography, x-ray diffraction, and electron microprobe studies. There is only one intermediate phase and it has a $Cr_3Si$(A15)-type crystal structure. The fcc platinum terminal solid solution extends to 71 at.pct Cr at 1530 °C and forms a congruent melting maximum at about 1790 °C. Atomic ordering within this solid solution range begins at about 17 at.pct Cr and there is a continuous change from the $Cu_3Au$-type structure to the CuAu-type structure with increasing chromium content. Two eutectic reactions at $1530 \pm 10$ °C and $1500 \pm 10$ °C were indicated and there is evidence of a syntectic reaction at $1580 \pm 10$ °C. Platinum is soluble in the bcc chromium terminal solid solution up to about 10 at.pct Pt at 1500 °C but the solubility decreases rapidly at lower temperatures.

**13622.** Waterstrat, R. M., Manuszewski, R. C., **The chromium-iridium constitution diagram,** *J. Less-Common Metals* **32,** 79-89 (1973).

Key words: Chromium alloys; constitution diagram; equilibrium diagram; iridium alloys; phase diagram.

The Cr-Ir alloy system has been investigated over the entire composition range by metallography, x-ray diffraction and electron microprobe studies. There are two intermediate phases in this system. The $\beta$ phase possesses a $Cr_3Si$ ($A15$)-type crystal structure and is stable from about 73 to 82 at.% Cr. The $\epsilon$ phase has a hexagonal close-packed crystal structure and is stable between 30 and 68 at.% Cr. The face-centered cubic iridium terminal solid solution can dissolve about 28 at.% Cr. Atomic ordering occurs within this solid solution, beginning at about 16 at.% Cr and forming a $Cu_3Au$ type structure up to the limit of solid solubility. Iridium is soluble in the body-centered cubic chromium terminal solid solution to the extent of about 12 at.% Ir at 1680 °C but the solubility decreases at lower temperatures. Two peritectic reactions were observed at $1750 \pm 10$ °C and at $2200 \pm 50$ °C. A eutectic reaction is indicated at $1680 \pm 10$ °C.

**13623.** Mosburg, E. R., Jr., **A study of the CW 28-$\mu$m water-vapor laser,** *IEEE J. Quantum Electron.* **QE-9,** No. 8, 843-851 (Aug. 1973).

Key words: Infrared laser; vibrational excitation; water vapor discharge; water vapor laser.

The low signal gain of a CW water-vapor laser at 28 $\mu$m was measured as a function of the discharge current and pressure. Together with the measurement of other quantities such as the axial electric field and the concentration of OH, a partial interpretation of the mechanisms involved in pumping the 28-$\mu$m transition was possible. Thermal equilibrium between the $\nu_0$, $2\nu_2$, and $\nu_3$ vibrational levels will result in a large absorption at the elevated gas temperatures observed (800-1000 K). The strong dependence of gain on the electron temperature strongly suggests that the vibrational excitation proceeds through electron-impact excitation. Only the electron-impact excitation of $H_2O$ is quantitatively capable of overcoming the large thermally induced absorption. Although vibrational-excitation transfer from $H_2$ to $H_2O$ seems insufficient, by itself, to overcome this absorption, it may provide appreciable additional gain. Pumping of the 28-$\mu$m line through electron-ion recombination and by reactions involving OH can be ruled out.

**13624.** Sparks, L. L., Powell, R. L., **Calibration of capsule platinum resistance thermometers at the triple point of water,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4,** Part 2, 1415-1421 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Resistance thermometers; temperature measuring instruments; triple point; water.

Temperature determinations by means of a platinum resistance thermometer, both above and below the triple point temperature of water, depend upon an accurate value for the resistance at the triple point, 0.01 °C. A good general methodology for making such a determination was described by H. F. Stimson at the 1955 Temperature Symposium. However, several aspects of the method must be refined or modified for accurate measurements on capsule thermometers. After a series of development tests, we were able to isolate and correct for several types of systematic experimental errors that were significant, but not immediately obvious. Some of the effects that must be carefully controlled in order to guarantee high precision are (1) thermal resistance between the thermometer and the freezing interface; (2) thermal conductance down to the thermometer from the ambient environment; (3) high-resistance electrical leakage between leads in the heat exchange fluid; and (4) freezing conditions in the triple point cell itself. Using the procedures developed during the test program, we have been able to obtain reproducibilities and statistical imprecisions of about 10 $\mu\Omega$ or 100 $\mu$K.

**13625.** Molino, J. A., **Pure-tone equal-loudness contours for standard tones of different frequencies,** *Perception Psychophysics* **14,** No. 1, 1-4 (1973).

Key words: Loudness; noise; psychoacoustics; psychophysics.

Six Ss made judgments of equal loudness by adjusting the intensity of comparison tones of 10 different frequencies. The comparison tones were presented diotically alternately with standard tones. Each standard tone remained fixed at one frequency (125, 1,000, or 8,000 Hz) and one intensity (10, 20, 40, or 70 dB sensation level) while collecting the data for any single equal-loudness contour. In this manner, families of equal-loudness contours were generated for each of the three standard frequencies. The contours for the 1,000-Hz standard were compared with those in the literature. The families of contours for the 125- and 8,000-Hz standards, determined by the same algorithm, differed in the spacing of the contours from the 1,000-Hz standard family as well as from each other. Implications for the reflexive, symmetric, and transitive properties of the equal-loudness relation are discussed.

**13626.** Furukawa, G. T., Reilly, M. L., **Application of precise heat-capacity data to the analysis of the temperature intervals of the international practical temperature scale of 1968 in the region of 90 K,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry*, H. H. Plumb, Editor-in-Chief, **4,** Part 1A, 27-36 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Heat capacity; specific heat; temperature intervals; temperature scale.

Precise heat-capacity data were employed to analyze the temperature intervals or smoothness of the International Practical Temperature Scale of 1968 (IPTS-68) between 15 and 380 K, particularly in the region of 90 K, as it is maintained at the National Bureau of Standards. Results show that there are no local irregularities in the temperature scale within the precision ($\pm 0.02$ percent) of the heat-capacity data between 40 and 380 K. Below 40 to 15 K the uniformity of the temperature scale is less

certain because of the lower precision of the heat-capacity data in the temperature range.

**13627.** Newell, A. C., Baird, R. C., Wacker, P. F., **Accurate measurement of antenna gain and polarization at reduced distances by an extrapolation technique,** *IEEE Trans. Antennas Propagat.* **AP-21,** No. 4, 418-431 (July 1973).

Key words: Antenna gain; antenna polarization; extrapolation technique; 3-antenna technique.

A new technique is described for determining power gain and polarization of antennas at reduced range distances. It is based on a generalized three-antenna approach which, for the first time, permits absolute gain and polarization measurements to be performed without quantitative *a priori* knowledge of the antennas. The required data are obtained by an extrapolation technique which includes provisions for rigorously evaluating and correcting for errors due to proximity and multipath interference effects. The theoretical basis provides a convenient and powerful approach for describing and solving antenna measurement problems, and the experimental method employed illustrates the utility of this approach. Examples of measurements are included which exhibit errors in gain as small as $\pm 0.11$ dB ($3\sigma$).

**13628.** Klein, W., **Perturbation solution of the Kirkwood-Salsburg equation,** *J. Math. Phys.* **14,** No. 8, 1049-1059 (Aug. 1973).

Key words: Asymptotic behavior at large cluster separations; Banach space; Kirkwood Salsburg equation; perturbation expansion; product property; strip operator approximation.

A formal series solution to the Kirkwood-Salsburg equation and its radius of convergence are derived. This solution leads naturally to the establishment of an approximate hierarchy of equations for the distribution functions which needs no closure. The asymptotic behavior of the solutions to this approximate hierarchy is studied as well as the behavior of the derivatives of the pair function with respect to the interparticle distance.

**13629.** Mandel, J., **Structure analysis in two-way tables of measurement data,** *Proc. 39th Session of the International Statistical Institute, Vienna, Austria, Aug. 20-30, 1973,* **2,** 697-705 (International Statistical Institute, Vienna, Austria, 1973).

Key words: Analysis of variance; interaction; principal components; structure; two-way tables.

A general procedure is presented for the elucidation of the structure of a two-way table. The method is based on a partitioning of the row by column interaction into a sum of multiplicative terms. To this partitioning corresponds a breakdown of the sum of squares of interaction and of the corresponding degrees of freedom in the analysis of variance table.

By studying the interrelationships of the parameters occurring in the model, the internal structure of the data can generally be ascertained. An illustrative example taken from an actual study is discussed.

**13630.** Hjortenberg, P. E., McLaughlin, W. L., **Use of radiochromic dye systems for dosimetry,** (Proc. Regional Conf. on Radiation Protection, Jerusalem, Israel, Mar. 1973), Paper in *Radiation Protection,* Y. Feige and T. S. Schlesinger, Eds., **1,** 122-140 (Israel Atomic Energy Commission, Yavne, Israel, 1973).

Key words: Accelerator; blood irradiators; dosimetry; electron beams; gamma rays; radiochromic dyes; x-rays.

Radiochromic dye systems have been developed at the U.S. National Bureau of Standards and have been further investigated at the Accelerator Department, The Danish Atomic Energy Commission Research Establishment Riso. Measurable absorbed doses range from $10^2$ to $10^8$ rads, depending on the particular system. Some characteristic properties are as follows: long shelf life, dose rate independence, low atomic number constituents (C, H, N, O), small temperature dependence, sensitivity to ultraviolet light, linear dose response, rather insensitive to organic impurities. In this paper a liquid system with a useful dose range of $10^2$-$10^5$ rads is described. Results demonstrate its capabilities for calibration of radiation fields including isotope irradiators and electron accelerators. Intercomparisons were made with Fricke- and thermoluminescence dosimetry.

**13631.** Benzinger, M., Benzinger, T. H., **Tympanic clinical temperature,** (Proc. 5th Symp. on Temperature, Its Measurement and Control in Science and Industry, Washington, D.C., June 21-24, 1971), Paper in *Temperature, Its Measurement and Control in Science and Industry,* H. H. Plumb, Editor-in-Chief, **4,** Part 3, 2089-2102 (Instrument Society of America, Pittsburgh, Pa., 1972).

Key words: Anesthesiology; brain temperature; carotid artery; clinical medicine; cold stress (diver); disposable thermometry; esophageal thermometer; fever; fulminant hyperpyrexia; heart temperature; hypothalamus heat stress; hypothermia; obstetrics; ovulation-detection; open heart surgery; pediatric surgery; pyrogens; sweating; temperature, central body; thermocouple disconnect; thermoelectric thermometry; thermometer; vasodilation; warm sensitive neurons.

Tympanic thermometry, first introduced in physiology where it was instrumental in finding the mechanisms of human temperature regulation, has passed the test of application to clinical medicine. In the clinical situations thus far tested, which included anesthesia of various types, hypothermia for surgery, extreme heat and cold stress, extracorporeal circulation for open heart procedure and one case of terminal cooling toward exitum after stroke, tympanic and esophageal patterns were found identical for practical purposes. Rectal tracings deviated grossly from the significant central patterns which monitor the temperature of the heart, the brain and the centers of thermoregulation. These central patterns can now be conveniently obtained, by way of the tympanic approach, with clean disposable probes on awake patients, and without embarrassment, discomfort or airway interference, in hospitals or at home. For hospital use, instruments are commercially available. For home use, small and inexpensive readout instruments have yet to be developed.

**13632.** Powell, C. J., **Semiautomated data-recording and control system for an electron energy analyzer,** *Rev. Sci. Instrum.* **44,** No. 8, 1031-1033 (Aug. 1973).

Key words: Auger-electron spectra; characteristic electron energy-loss spectra; digital data-recording and control system; electron energy analyzer; liquid aluminum; tungsten.

A description is given of a digital data-recording and control system that has been used with a high resolution low energy electron scattering apparatus for the measurement of characteristic electron energy-loss spectra and Auger-electron spectra of solids (at room and elevated temperatures) and liquids. This system is based on a multichannel analyzer and has the following features: (a) Specimens can be prepared many times with data accumulated in arbitrarily short times after preparation (prior to specimen contamination), and final spectra of high precision can be obtained by summation of individual runs; (b) the voltage sweep applied to the electron energy analyzer can be calibrated dynamically; and (c) data can be accumulated and the target heated by electron bombardment in a cyclic manner with varia-

ble accumulation and heating periods. Characteristic loss spectra of tungsten at 800 °C and of liquid aluminum are presented as examples of operation of the system.

**13633.** Gadzuk, J. W., Plummer, E. W., **Field emission energy distribution (FEED)**, *Rev. Mod. Phys.* **45**, No. 3, 487-548 (July 1973).

Key words: Chemisorption; electronic properties of metals; field emission; surface physics.

The technique of measuring the energy distribution of electrons which have been field emitted from a cold cathode is considered. The general historical and introductory theory is presented. A survey of the experimental techniques and existing energy analyzers is given. Specific studies on clean metal surfaces in which work functions, band structure effects, surface states, thermal effects, and many-body effects have been studied are reviewed from both the experimental and theoretical points of view. Field emission energy distributions have been particularly valuable in studies of atoms chemisorbed on surfaces. Several theories of enhanced resonance tunneling due to chemisorbed atoms are discussed. Specific systems studied experimentally are reviewed. Inelastic adsorbate enhanced tunneling is also treated.

**13634.** Mullen, L. O., **High and ultra-high vacuum by pumping with cryocooled surfaces**, (Proc. American Institute of Chemical Engineers, Symp. Series on Cryogenic Pumping, Denver, Colo., 1971), Paper in *Vacuum Technology at Low Temperatures* **125**, No. 68, 24-30 (1972).

Key words: Cryopumping; cryosorption; gettering; vacuum pump; vapor pressures.

This presentation reviews the principles of pumping with cryogenically-cooled surfaces to produce high and ultra-high vacuum. The theory of cryopumping and entrapment by cryopumping, as well as some advantages and limitations are discussed.

**13635.** Morrissey, B. W., Powell, C. J., **Interpolation of refractive index data**, *Appl. Opt.* **12**, No. 7, 1588-1591 (July 1973).

Key words: Cubic-spline interpolation; cyclohexane; interpolation; polystyrene; refractive index; sapphire.

A comparison of the interpolation of index of refraction data for Czochralski sapphire, cyclohexane, and polystyrene dissolved in cyclohexane using a three-term Sellmeier equation, the Lorentz-Lorenz equation with six terms, third and fifth order polynomials, and a cubic-spline technique indicates that the cubic spline method is extremely valuable for simple interpolation. Not only were the magnitudes of the rms and average absolute residuals the smallest, but the fits showed no systematic errors.

**13636.** Unassigned.

**13637.** Masters, L. W., Wolfe, W. C., Rossiter, W. J., Jr., Shaver, J. R., **State of the art on durability testing of building components and materials**, *NBSIR 73-132*, 128 pages (Mar. 1973). (Available as PB222300 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accelerated aging; aging of buildings; building components; climate; criteria; deterioration; durability; materials; mechanisms; nondestructive testing; testing.

This report is a summary of the present knowledge pertaining to durability predictions for building components and materials which are subjected to the effects of outdoor exposure. The various chapters of the report include discussions of the nature of aging, the measurement of properties to predict durability, nondestructive evaluation techniques, outdoor exposure techniques, accelerated aging techniques, techniques for applying testing data to durability predictions and difficulties which arise in predicting durability. Conclusions and recommendations are also included.

An appendix, which summarizes ASTM Standards for durability testing of building components and materials, is included.

**13638.** Cohen, E. R., Taylor, B. N., **A reevaluation of the fundamental physical constants**, (Proc. 4th Int. Conference on Atomic Masses and Fundamental Constants, Teddington, England, Sept. 3-7, 1971), Paper in *Atomic Masses and Fundamental Constants*, J. H. Sanders and A. H. Wapstra, Eds., Part 13, 543-563 (Plenum Publishing Co., New York, N.Y., 1972).

Key words: Data analysis; fundamental constants; least-squares adjustments.

This paper is a progress report on our current efforts to revise and update the comprehensive review of the fundamental physical constants by Taylor, Parker, and Langenberg (1), including their set of best or recommended values. That such an updating is necessary just two years after their review appeared is due to the extraordinary amount of new experimental and theoretical work which has since been completed. Here, we very briefly summarize the experimental and theoretical evidence, with emphasis on the new results which have become available within the last two years, and discuss various treatments of the data. However, no new set of recommended constants is given since such a set will necessarily require the inclusion of the new data which has become available at this Conference.

**13639.** Haar, L., **The ideal gas-calorimetric thermometer**, *Science* **176**, 1293-1296 (June 23, 1972).

Key words: Ammonia; calorimetry; flow calorimeter; heat capacity; ideal-gas; temperature; thermodynamic temperature; thermometer.

A new thermometer is suggested for probing the difference between the thermodynamic temperature scale and a practical scale, say the International Practical Temperature Scale—1968. The method is based on the fact that the fractional difference of the heat capacity as measured on two scales is very nearly equal to the temperature derivative of the difference in hotness between the scales. Now, the heat capacity on the thermodynamic scale is by definition that of the ideal gas calculated from the molecular structure using statistical mechanics. This we compare with the analogous quantity measured calorimetrically and extrapolated to the ideal gas limit. The feasibility of the method is illustrated using very accurate data for gaseous ammonia.

**13640.** Barber, W. C., Hayward, E., Sazama, J., **Nuclear scattering of plane-polarized photons**, (Proc. Int. Conf. on Nuclear Structure Studies using Electron Scattering and Photoreaction, Sendai, Japan, Sept. 12-15, 1972), Paper in *Nuclear Structure Studies Using Electron Scattering and Photoreaction*, Supplement to *Research Report of Laboratory of Nuclear Science*, K. Shoda and H. Ui, Eds., **5**, 313-317 (Tohoku University, Tomizawa, Sendai, Japan, 1972).

Key words: Dynamic collective model; giant resonance; photon scattering; polarized photons.

A beam of plane-polarized, monochromatic photons has been produced by the resonance fluorescence of the well-known $1^+$ state in $^{12}C$. These have been scattered a second time from targets of cadmium, tin, tantalum, gold, and bismuth. A measurement of the number of photons scattered along and perpendicular

to the polarization vector in the incident 15.1 MeV beam allows a determination of the relative contribution of incoherent and coherent scattering to the total scattering cross section. These results can be compared to the predictions of the dynamic collective model.

**13641.** LaFleur, P. D., Thompson, B. A., **Gamma-ray spectroscopy,** Paper in the *Encyclopedia of Chemistry, Third Edition,* C. Hampel and G. G. Hawley, Eds., pp. 1032-1033 (Van Nostrand Reinhold Co., New York, N.Y., 1973).

Key words: Activation analysis; gamma-ray spectroscopy; Ge(Li) detectors; group separations; instrumentation.

This article has been prepared for the third edition of the Encyclopedia of Chemistry. It is a revision of an article which appeared in the previous edition, published by Reinhold Publishing Company in 1966.

**13642.** Gilman, F) J., Kugler, M., Meshkov, S., **Pionic transitions as tests of the connection between current and constituent quarks,** *Phys. Lett.* **45B,** No. 5, 481-486 (Aug. 20, 1973).

Key words: Baryon decays; constituent quarks; current quarks; pionic transitions; su(3); $su(6)_w$.

A proposed connection between current and constituent quarks is discussed and tested through comparison with the magnitudes and signs of amplitudes for pionic transitions between hadrons.

**13643.** Fatiadi, A. J., **Facile coupling of sterically hindered 2,6-dialkylphenols with periodic acid,** *Synthesis Commun.* No. 6, 357-358 (June 1973).

Key words: Coupling; dialkylphenols; dimethylformamide; hindered; oxidation; periodic acid.

A procedure has been developed by which sterically hindered phenols can produce coupling products (diphenoquinones) in 60 to 94 percent yield when treated with periodic acid in an aqueous N,N-dimethylformamide.

**13644.** Saks, T. H., Yates, R. F., Goodman, K. M., **The Shirley Highway Express-Bus-on-Freeway demonstration project-users' reactions to innovative bus features,** *NBSIR 73-265,* 53 pages (June 1973). (Available as COM 73-11453 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Attitudinal survey; bus-on-freeway; exclusive bus lanes; importance assessments; interior bus features; mass transit technology; satisfaction assessments; transit service features.

The Shirley Highway Express Bus-on-Freeway Project demonstrates the application of a new mass transit technology. The elements tested in this demonstration project include: an exclusive bus lane in the median of a freeway and bus priority lanes in the downtown distribution area; fringe parking facilities which are coordinated with the bus service; new-look/new-feature buses; and extension of service to additional residential areas in an overall systems approach to the improvement of mass transit. As part of the evaluation of this demonstration project, a survey of commuters on board these buses was undertaken in order to obtain users attitudes concerning the special interior bus features as well as transit service features.

The results obtained from this study should be of interest to persons considering how to allocate expenditures for new bus vehicles and transit service improvements.

Bus commuters perceptions of the relative importance of various bus interior features (i.e., carpeting, special lighting, etc.) and transit service features (i.e., reliable schedules, assurance of a seat, etc.) are analyzed in this report, along with their relative satisfaction assessments of the special bus interior features. Analyses were conducted to determine if marginal improvements in interior comfort and aesthetic features proved significantly more appealing to bus commuters. The relative impact of various project marketing and promotional techniques is also presented.

**13645.** Smith, M. W., Martin, G. A., Wiese, W. L., **Systematic trends and atomic oscillator strengths,** *Nucl. Instrum. Methods* **110,** 219-226 (1973).

Key words: Atomic oscillator strengths; homologous atoms; isoelectronic sequences; regularities; spectral series; systematic trends.

A number of newly established or significantly improved systematic trends of atomic oscillator strengths in isoelectronic sequences and spectral series are presented. For most of these trends, beam-foil experiments have played a prominent role in supplying critically needed points. Of particular interest are the changes in several transitions of the Be and C sequences brought about by improved beam-foil results and more refined theoretical calculations. Also of significance are newly detected trends in the Li and Al isoelectronic sequences. An example will be given where the analysis of the *f*-value dependence along a sequence, coupled with an understanding of the changes in the energy level structure, points out areas where future beam-foil experiments would be desirable in clearing up discrepancies. The $n^{*3}$ dependence of oscillator strengths for perturbed series will be illustrated with another interesting example.

**13646.** Ott, W. R., Wiese, W. L., **Far ultraviolet spectral radiance calibrations at NBS,** *Opt. Eng.* **12,** No. 3, 86-94 (May/June 1973).

Key words: Calibrations; deuterium lamp; far ultraviolet; hydrogen; Krefft-Rössler lamp; spectral radiance; transfer standards; wall-stabilized arc.

The range of NBS radiometric calibration services has been extended into the far ultraviolet region of the spectrum where a dc high power hydrogen wall-stabilized arc is used as a primary standard of spectral radiance. A capability in the range 130 nm to 360 nm (overlapping conventional tungsten strip lamp radiometry) is presently available with estimated uncertainties between 5 and 10 percent depending upon wavelength. The status of radiometric source standards in the far ultraviolet is briefly reviewed and the hydrogen arc and NBS calibration facility are described in detail. The use of commercially available mercury Krefft-Rössler lamps and deuterium arc lamps as transfer or secondary standards is discussed and the spectra of these lamps calibrated with the hydrogen arc standard are presented.

**13647.** Dellepiane, G., Gussoni, M., Hougen, J. T., **Hamiltonian, symmetry group, and vibrational coordinates for the nonrigid molecule $CXY_2 - C \equiv C - CXY_2$,** *J. Mol. Spectrosc.* **47,** No. 3, 515-530 (Sept. 1973).

Key words: Double-valued presentation; free internal rotation; Hamiltonian energy operator; non-rigid molecules; permutation-inversion group; vibrational coordinates.

A vibration-torsion-rotation Hamiltonian is derived for a molecule of the type $CXY_2 - C \equiv C - CXY_2$ exhibiting nearly free internal rotation. The Hamiltonian obtained preserves many of the features of the ordinary Wilson-Howard vibration-rotation Hamiltonian and is based qualitatively on the idea of a slowly varying torsional reference configuration from which the atoms make rapid vibrational displacements. The appropriate molecular symmetry group for this molecule is found to be a double



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group of the simple Longuet-Higgins permutation-inversion symmetry group. The indeterminacy of symmetry species (single-valued vs double-valued) for coordinates used to describe the small amplitude vibrations is illustrated and clarified using a simple model for the skeletal bending vibrations.

**13648.** Christ, B. W., **Effects of misalignment on the pre-macroyield region of the uniaxial stress-strain curve,** *Met. Trans.* **4,** 1961-1965 (Aug. 1973).

Key words: Bending; capacitance strain gage; tensile; Ti-6Al-4V; uniaxial loading; 4340 steel.

Some bending usually occurs in uniaxial testing systems due to small unavoidable misalignment. The resulting elastic strain gradient can lead to significant differences between axial strain and extreme surface bending strains, especially at small strains. A three-point microstrain measurement around a cylindrical sample permits evaluation of the extreme strains and of the precision of alignment. A three-point, parallel-plate capacitance strain gage having a linear output with displacement was designed to evaluate bending of tensile samples in the microstrain range. The resolution of the gage was 3 parts in 10,000 at plate separations of 0.010 in. Varying misalignment resulted in extreme elastic bending strains at the sample surface of the order of tens to hundreds of micro-in. per in. larger than the axial strain. Analysis of the mechanics of bending in uniaxial loading demonstrated that: 1) the average applied stress divided by the average elastic strain always gives a unique number, Young's modulus, and 2) the average microplastic strain is not uniquely related to the average applied stress, but rather depends upon precision of alignment. The influence of bending on the determination of the average stress at which microplastic flow initiates is discussed, and a method for making meaningful comparisons of plastic microstrain data generated with significant misalignment is suggested.

**13649.** Maki, A. G., **Infrared spectra of $CS_2$: Measurement of "hot" bands associated with the 2325 $cm^{-1}$ and 2962 $cm^{-1}$ bands,** *J. Mol. Spectrosc.* **47,** No. 2, 217-225 (Aug. 1973).

Key words: Absorption spectra; carbon disulfide; energy levels; high resolution; infrared; molecular spectra.

The $12^01 - 00^00$ and $02^01 - 00^00$ transitions of $CS_2$ have been measured with a resolution of 0.025 $cm^{-1}$. The following "hot" bands associated with these transitions were also measured $13^11 - 01^10$, $22^01 - 10^00$, $14^01 - 02^00$, $14^21 - 02^20$, $03^11 - 01^10$, $12^01 - 10^00$, $04^01 - 02^00$, $04^21 - 02^20$, $13^11 - 11^10$, and $22^01 - 20^00$. Improved rotational constants are given for the ground state and the first bending state. A consistent set of band constants is given for all the above vibrational transitions.

**13650.** Comeford, J. J., Birky, M., **A method for the measurement of smoke and HCl evolution from poly(vinyl chloride),** *Fire Technol.* **8,** No. 2, 85-90 (May 1972).

Key words: HCl; He-Ne laser; poly(vinyl chloride); pyrolysis; smoke; thermal decomposition.

As poly(vinyl chloride) becomes more popular as a building material and electrical insulation, it becomes more important to life safety to determine its smoke and hydrogen chloride evolution characteristics during pyrolysis. The authors have devised a method of measuring the two simultaneously.

**13651.** Creitz, E. C., **Extinction of fires by halogenated compounds—a suggested mechanism,** *Fire Technol.* **8,** No. 2, 131-141 (May 1972).

Key words: Extinguishment; flame inhibition; inhibition mechanisms.

It is suggested that halogenated compounds extinguish diffusion flames by promoting recombination of reactive oxygen atoms to form less reactive molecular oxygen. Oxygen atoms are important in the branching steps of the hydrogen-oxygen chain reaction. For a fuel containing carbon, CO is an intermediate product which appears in the region in which inhibition takes place. Inhibition of its oxidation appears to take place because of the paucity of hydroxyl radicals which are a product of the hydrogen-oxygen chain reaction. The mechanism is suggested in an attempt to rationalize a number of apparently disparate observations reported in the literature of both normal and inhibited flames. Data in support of the suggested mechanism are discussed.

**13652.** Ott, W. R., Fieffe-Prevost, P., Wiese, W. L., **VUV radiometry with hydrogen arcs. 1: Principle of the method and comparisons with blackbody calibrations from 1650 Å to 3600 Å,** *Appl. Opt.* **12,** No. 7, 1618-1629 (July 1973).

Key words: Continuum emission coefficient; hydrogen arc; radiometry; vacuum ultraviolet.

A method is described that utilizes the continuum emission from a wall-stabilized arc discharge as a radiometric standard in the vuv. Ultimately, this standard will cover the wavelength range from 500 Å to 3600 Å. Results of a first experiment comparing this method to two other calibration methods in the region above 1650 Å are presented. A calibrated tungsten strip lamp is used between 2500 Å and 3600 Å; the method of blackbody limited lines is applied at two wavelengths in the vuv. The hydrogen arc method depends upon the fact that the continuum emission coefficient for a hydrogen plasma at typical arc temperatures of about 14,000 K is calculable to within a few percent since the essential spectroscopic constants, continuum absorption coefficients, and transition probabilities are exactly known. The accuracy of the method depends primarily on the capability of spatially resolving in an end-on measurement the nearly homogeneous plasma layers near the axis of the cylindrically symmetric arc column.

**13653.** Maki, A. G., Johnson, D. R., **Microwave spectra of carbonyl sulfide: Measurements of ground state and vibrationally excited $^{16}O^{13}C^{32}S$, $^{18}O^{12}C^{32}S$, and other isotopic species,** *J. Mol. Spectrosc.* **47,** No. 2, 226-233 (Aug. 1973).

Key words: Bond distances; carbonyl sulfide; microwave spectra; molecular parameters; rotational transitions; spectra.

Microwave measurements have been made on isotopically enriched samples of $^{13}C$-carbonyl sulfide and $^{18}O$-carbonyl sulfide. Centrifugal distortion constants and *l*-type doubling constants have been determined for these isotopically substituted molecules. Rotational constants have been measured for all vibrational states below 2150 $cm^{-1}$ and $B_e$ values have been determined. The equilibrium bond distances calculated from different pairs of isotopes are compared and a substitution equilibrium structure is given. Some new measurements are also reported for the isotopic species $^{18}O^{13}C^{32}S$, $^{18}O^{13}C^{34}S$, $^{18}O^{12}C^{34}S$, and $^{16}O^{13}C^{34}S$.

**13654.** Bellet, J., Lafferty, W. J., Steenbeckeliers, G., **Microwave spectra of $D_2{}^{17}O$ and $D_2{}^{18}O$,** *J. Mol. Spectrosc.* **47,** No. 3, 388-402 (Sept. 1973).

Key words: Centrifugal distortion constants; $D_2{}^{17}O$; $D_2{}^{18}O$; quadrupole coupling constants; rotational constants; rotational spectra.

Forty lines of the microwave spectra of $D_2{}^{17}O$ and $D_2{}^{18}O$ have been measured in the region from 8 to 400 GHz and analyzed ac-

cording to Watson's centrifugal distortion theory. Comparison of the results obtained for $D_2{}^{16}O$, $D_2{}^{17}O$, and $D_2{}^{18}O$ demonstrates their internal consistency. The transferability of the parameters according to the isotopic substitution rules is evidence for the validity of the model chosen for the study of the ground state of heavy water.

The effective rotational constants deduced from the observed spectra are very close to the values calculated using Oka's second order theory. The values obtained in MHz are:

$$A = 456766.9, B = 218041.0, C = 144701.5 \ (D_2{}^{17}O);$$

$$A = 451891.9, B = 218045.2, C = 144201.7 \ (D_2{}^{18}O).$$

The hyperfine structure of the $D_2{}^{17}O$ lines has been analyzed using as a reference the corresponding quadrupole coupling tensor of $HD^{17}O$ with the appropriate rotation. The values of $\chi_{yy}$ in MHz used for the analysis are:

$$\chi_{xx} = -1.2104, \chi_{yy} = 10.1068, \chi_{zz} = -8.8964.$$

**13654A.** Roberts, R. W., **1973 INTERMAG keynote address: NBS—The magnetic domain,** *IEEE Trans. Magn.* **MAG-9,** No. 3, 152-155 (Sept. 1973).

Key words: Magnetic research; magnetism.

The National Bureau of Standards has been active in magnetic research for 70 years, in such areas as theory, development of magnetic devices, and use of magnetism in other scientific investigations. Highlights of NBS programs, past and present, are featured.

**13655.** Olf, H. G., Fanconi, B., **Low frequency Raman-active lattice vibrations of *n*-paraffins,** *J. Chem. Phys.* **59,** No. 1, 534-544 (July 1, 1973).

Key words: *n*-paraffins; polyethylene phonon dispersion curves; Raman spectroscopy-lattice vibrations.

Raman spectra in the frequency range $5 - 200$ cm$^{-1}$ have been measured for a series of crystalline *n*-paraffins from *n*-$C_5H_{12}$ to *n*-$C_{26}H_{54}$ and also *n*-$C_{32}H_{66}$, *n*-$C_{35}H_{72}$, and *n*-$C_{36}H_{74}$. It is found that the spectral data may be grouped consonant with crystal structures exhibited by *n*-paraffins. The data are used to map out portions of the transverse acoustical phonon dispersion curves of the orthorhombic polyethylenelike lattice and of one triclinic crystalline form. A band whose frequency is independent of chain length is observed for the orthorhombic *n*-paraffins and is assigned to the $B_{3g}$ rotatory lattice mode of polyethylene.

**13656.** Barnes, J. D., **Inelastic neutron scattering study of the "rotator" phase transition in *n*-nonadecane,** *J. Phys. Chem.* **58,** No. 12, 5193-5201 (June 15, 1973).

Key words: Molecular dynamics; *n*-alkanes; *n*-nonadecane; neutron scattering; paraffin; rotator phase.

A simple kinematic model for rotational jump diffusion of a normal alkane about its long axis (circular random walk model) is developed. Inelastic neutron scattering data obtained on the Fermi chopper time-of-flight instrument at the National Bureau of Standards reactor using an incident neutron wavelength of 2.47 Å ($\Delta\lambda/\lambda \simeq 3.8$ %) are compared with the predictions of the model. Data taken below the temperature of the "rotator" phase transition in *n*-nonadecane (295 °K) show no quasielastic scattering due to diffusive motions. Data taken in *n*-nonadecane in its disordered solid phase show quasielastic scattering consistent with the circular random walk model. Estimates for values of the model parameters of 3.5 psec. for $\tau_1$ and $N \geq 8$ are obtained.

**13657.** Creitz, E. C., **Gas chromatographic determination of composition profiles of stable species around a propane diffusion flame,** *J. Chromatogr. Sci.* **10,** 168-173 (Mar. 1972).

Key words: Flame gases; flame inhibition; gas analysis; gas chromatographic techniques.

An analytical method was developed for determining, quantitatively, with a GC, the gases present around a 2.4 cm high propane diffusion flame burning in air. The method gives quantitative results on samples having some constituents which may not be eluted from the column. Outside the yellow mantle the only fuel species found were carbon, hydrogen and carbon monoxide. The oxygen concentration dropped to zero at a distance of 0.57 mm from the yellow mantle indicating that pyrolysis of the fuel was essentially without $O_2$. The absence of other fuel species implicates the hydrogen-oxygen chain reaction as having a part in the mechanism of inhibition. When $CF_3Br$ was added to the air, its decomposition was complete at a distance of 2.56 mm from the yellow mantle. The decomposition appeared to be chemical rather than thermal.

**13658.** Chertok, B. T., Sheffield, C., Lightbody, J. W., Jr., Penner, S., Blum, D., **Low-$q^2$ electron scattering from the 15.109-MeV state of $^{12}$C and the conserved-vector-current test,** *Phys. Rev. C* **8,** No. 1, 23-36 (July 1973).

Key words: Electron scattering; extrapolation, $\Gamma_\gamma$; low $q^2$; $1^+$ state; 15.11 MeV.

High-precision electron scattering measurements from the 15.109-MeV $1^+$ state in $^{12}$C are made at $\theta = 75$ and 110 ° with $35 \leq E \leq 55$ MeV. From the measurements $B(M1)$ is extrapolated to the photon point and the radiative width is determined, $\Gamma_\gamma = 37.0 \pm 1.1$ eV. The corresponding weak magnetism results for $\beta$ decay and $\mu$ capture are given.

**13659.** Coriell, S. R., Sekerka, R. F., **Morphological stability near a grain boundary groove in a solid-liquid interface during solidification of a binary alloy,** *J. Cryst. Growth* **19,** 285-293 (1973).

Key words: Alloy; grain boundary; morphology; solidification; stability.

In order to further explore the influence of grain boundaries on the phenomenon of morphological stability, we have extended our previous treatment for a pure substance to a binary alloy. For unidirectional solidification at constant velocity, the shape, $y = W(x,t)$, of a nearly planar interface, intersected perpendicularly by a grain boundary, is calculated. The stability-instability criterion is identical to that for an interface without a grain boundary. If the interface is unstable, the main influence of the grain boundary is to provide an initial perturbation and the time evolution of the interface shape can be treated by approximate analytical methods. For times sufficiently large that initial transients have decayed but sufficiently small that linear theory is applicable, $W(x,t)$ is proportional to $\exp(t/\tau)\cos(\omega_0 x)\exp(-x^2/4\mathscr{D}t)$, where $\omega_0$, $\tau$, and $\mathscr{D}$ are constants that depend on experimental conditions. After initial transients have decayed, a stable interface attains a time-independent shape. For this case, $W(x,t \to \infty)$ is evaluated numerically; it is found that $W(x,t \to \infty)$ can be an oscillatory function of x. The size of the oscillations and the depth of the grain boundary groove increase as the stability-instability demarcation is approached, giving the specious appearance of premature instability.

**13660.** Kaufman, V., Sugar, J., **One-electron spectrum of singly ionized ytterbium (Yb II),** *J. Opt. Soc. Amer.* **63,** No. 9, 1168-1172 (Sept. 1973).

Key words: Energy levels; spectrum; ytterbium.

The spectrum produced by the hollow-cathode discharge was measured from 2107 to 1377 Å. With these new data and the previously published observations of Yb II at longer wavelengths, new $4f^{14}nl$ series terms were found, including 10*s*, 7*p*, 7–11*d*, 5–14*f*, and 5–6g. A value of 98 269(50) $cm^{-1}$ was deduced for the ionization energy.

**13661.** Coriell, S. R., Sekerka, R. F., **Morphological stability near a grain boundary groove in a solid-liquid interface during solidification of a pure substance.** *J. Cryst. Growth* **19**, 90-104 (1972).

Key words: Crystal growth; grain boundary; morphological stability; solidification.

In order to explore the influence of a specific type of defect on the phenomenon of morphological instability, we have calculated the time-dependent shape of a nearly planar interface, intersected perpendicularly by a grain boundary, during solidification of a pure substance at constant velocity. The calculational methods and principal assumptions are similar to those employed in previous theories of morphological stability except that the slope of the interface is maintained at a finite and constant value, *s*, in the immediate vicinity of the grain boundary groove. The position of the solid-liquid interface is described by the equation $y = W(x,t)$ where $t$ is the time and $W(x,0) \to 0$ as $|x| \to \infty$ (all quantities are assumed independent of $z$). Whereas the stability-instability criterion is found to be identical to that for an interface without a grain boundary, the boundary is found to be an effective initial perturbation. Under conditions for instability the depth of the grain boundary groove increases exponentially with time and an oscillatory instability propagates laterally from the boundary. Under conditions for stability, the interface eventually attains a time-independent shape given by $W(x,t\to\infty) = (-s/a)\exp(-ax)$, where $a^2 = (\mathcal{G}_S + \mathcal{G}_L)/2T_M\Gamma$, $\mathcal{G}_S$ and $\mathcal{G}_L$ are conductivity-weighted temperature gradients in solid and liquid, respectively, $T_M$ is the melting temperature and $\Gamma$ is a capillary constant. For conditions corresponding to the demarcation between stability and instability, a mode of thermal grooving, similar to that previously described by Mullins, is found. A meaningful criterion for instability is shown to be the exponential growth of perturbations while, conversely, stability entails their exponential decay; phenomena such as the algebraic increase of amplitude characteristic of thermal grooving are shown to be manifestations of constraints. Finally, the situation where the interface shape is allowed to depend on $z$ is shown to be describable by a superposition of $W(x,t)$ with a function $W_0(x,z,t)$ that corresponds to the conventional case where the grain boundary is absent.

**13662.** Reader, J., Epstein, G., **Zeeman effect and revised analysis of singly ionized rubidium (Rb II),** *J. Opt. Soc. Amer.* **63, No. 9, 1153-1167 (Sept. 1973).**

Key words: Rubidium; spectra; ultraviolet; wavelengths; Zeeman effect.

The spectrum of Rb II has been observed in a sliding-spark discharge with the NBS 10.7-m normal-incidence vacuum spectrograph and in an electrodeless discharge with the NBS 10.7-m Eagle spectrograph in air. The Zeeman effect was observed from 2200 to 5200 Å with an electrodeless lamp in a magnetic field of 31 000 G. The analysis has confirmed all ten of the previously known levels of the $4p^5 5p$ configuration. The $4p^5 4d$, $4p^5 5s$, $4p^5 5d$, and $4p^5 6s$ configurations have been considerably revised and extended. Almost all levels of these configurations are now known, as well as those of $4p^5 6d$, $4p^5 7s$, and $4p^5 4f$, which were newly located. All configurations have been theoretically interpreted, with configuration interaction included. The energy parameters determined from a least-squares fit to the observed level values are compared with Hartree-Fock calculations. The ionization energy as derived from the $4p^5 ns$ series, $n = 5, 6, 7$, is $220\,070 \pm 25$ $cm^{-1}$ ($27.285 \pm 0.003$ eV).

**13663.** Yates, J. T., Jr., Madey, T. E., Dresser, M. J., **Adsorption and decomposition of formaldehyde on tungsten (100) and (111) crystal planes,** *J. Catal.* **30**, No. 2, 260-275 (Aug. 1973).

Key words: Carbon dioxide; catalytic; chemisorption; decomposition; formaldehyde; methane; tungsten.

The chemisorption of formaldehyde at ~ 100 K has been investigated on two single crystal planes of tungsten, W(100) and W(111). At low $H_2CO$ coverages, only $H_2$ and CO are observed as thermal desorption products. At higher $H_2CO$ coverages both $CH_4$ and $CO_2$ are observed as additional desorption products. Work function and flash desorption measurements indicate that the dissociative adsorption of $H_2CO$ into H(ads) and CO(ads) is accompanied at higher surface coverages by the formation of other surface complexes.

A detailed comparison of W(100) with W(111) indicates that crystallographic differences play a minor role in the surface catalyzed decomposition of $H_2CO$ by tungsten.

**13664.** Collier, R. S., Ellerbruch, D., Cruz, J. E., Stokes, R. W., Luft, P. E., Peterson, R. G., Hiester, A. E., **Mass quantity gauging by rf mode analysis,** *NBSIR 73-318*, 196 pages (June 1973). (Available as N73-27390 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Gauging; hydrogen; nitrogen; radio frequency; total mass.

This is a summary report of work done to date on NASA (Johnson Space Center) purchase order T-1738B concerning Radio Frequency (RF) Mass Quantity Gauging. Experimental apparatus has been designed and tested which measures the resonant frequencies of a tank in the "time domain." These frequencies correspond to the total mass of fluid within the tank. Experimental results are discussed for nitrogen and hydrogen in normal gravity both in the supercritical state and also in the two phase (liquid-gas) region. Theoretical discussions for more general cases are given.

**13665.** Bussey, H. E., **Wavelength of a slotted rectangular line containing two dielectrics,** *NBSIR 73-326*, 17 pages (July 1973). (Available as COM 73-11465-AS from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Capacitance; dielectric measurement; slab line; slotted line.

The titled electromagnetic wave property is obtained approximately for a rectangular slab line with two dielectrics. The perturbing dielectric is a thin sheet set on the center conductor and slotted to permit travel of the probe when the line is used as a slotted line. The purpose is to measure an unknown dielectric filling most of the line, but perturbed by the thin sheet.

**13666.** Giarrantano, P. J., Hess, R. C., Jones, M. C., **Forced convection heat transfer to subcritical helium I,** *NBSIR 73-322*, 43 pages (May 1973). (Available as COM 73-11464-AS from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Centrifugal pump; critical heat flux; film boiling; forced convection; heat transfer; helium; nucleate boiling; subcritical; supercritical.

Preliminary results of an experimental investigation of heat transfer to liquid helium under forced flow conditions are reported for a 0.213 cm i.d. × 10 cm long test section subject to the following range of operating conditions:

System pressures 1.1 – 2.1 atm

Mass velocities 4 – 64 g/s-cm²

Heat fluxes 0.04 – 0.53 W/cm²

Inlet subcooling 0.03 – 0.10 K

The effect of the above system parameters on the heat transfer and critical heat flux is discussed; a comparison of forced convection boiling with other modes of heat transfer (pool boiling and supercritical) and the performance of a centrifugal pump used for circulating the liquid helium are also included in the report.

**13667.** Diller, D. E., Sarkes, L. A., **Properties data for LNG,** *Amer. Gas Ass. Mon.* **55,** No. 9, 27-28 (Sept. 1973).

Key words: Calculation methods; densities; ethane; liquefied natural gas mixtures; methane; pure components; propane; properties data.

The need for new physical and thermodynamic properties data for liquefied natural gas mixtures at low temperatures is discussed. A plan is given for calculating properties data for liquid mixtures at temperatures well below the critical temperature. The National Bureau of Standards Cryogenics Division's program to provide accurate input data for calculating properties data for LNG is described.

**13668.** Mabie, C. P., **Petrographic study of the refractory performance of high-fusing dental alloy investments: II. Silica-bonded investments,** *J. Dent. Res.* **52,** No. 4, 758-773 (1973).

Key words: Alloy; casting; chromium; investment; mold.

Petrographic study of the refractory performance of silica-bonded investments revealed that recrystallized silica bonds consisting of tridymite and cristobalite are formed during burnout. The major reaction product created during casting is eskolaite. Liquefaction and sintering in the investment at and near its interface with the casting plugs pores and may lower permeability.

**13669.** Bowen, R. L., Argentar, H., **A method for determining the optimum peroxide-to-amine ratio for self-curing resins,** *J. Appl. Polym. Sci.* **17,** 2213-2222 (1973).

Key words: Accelerators; amines; dental materials; initiators; peroxides; polymerization.

The rate of polymerization of a methacrylate monomer was influenced by the molar ratio of benzoyl peroxide to an aromatic tertiary amine accelerator when the product of the concentrations of these was kept constant. The maximum rate, measured as the minimum gel time, occurred in monomer solutions containing about 1.5 moles of peroxide per mole of amine.

**13670.** Levine, J., Stebbins, R. T., **Ultrasensitive laser interferometers and their application to problems of geophysical interest,** *Phil. Trans. Roy. Soc. London A* **274,** 279-284 (1973).

Key words: Earth tides; interferometer; normal modes; strainmeter.

A 30 m laser strainmeter is currently being operated in an unworked gold mine near Boulder, Colorado. The strainmeter consists of an evacuated Fabry-Perot interferometer illuminated by a 3.39 $\mu$m He-Ne laser. A second 3.39 $\mu$m laser is stabilized by means of saturated absorption in methane and its wavelength serves as the reference length for the system. We shall describe the instrument in some detail and present the latest results in our investigation of the Earth tides and the Earth normal modes.

**13671.** Penn, D. R., **The concept of the surface molecule in chemisorption,** *Surface Sci.* **39,** 333-340 (1973).

Key words: Density of states at the adsorbate; energy levels; S state adsorbate; surface molecule; tight binding calculation; W substrate.

Under certain circumstances the binding of an adsorbate to a metal surface may be thought of as the formation of a surface molecule composed of the adsorbate and the metal. This point of view is reasonable if the metal density of states at the adsorbate resembles that of an atom, i.e., exhibits a small number of well defined peaks as a function of energy. The width of these peaks must be small compared to the metal band width. Within the context of a simple tight binding model for the metal we find that for an S state adsorbate on W there are certain adsorbate positions for which the surface molecule concept should be valid.

**13672.** Hastie, J. W., **Mass spectrometric analysis of 1 atm flames: Apparatus and the $CH_4-O_2$ system,** *Combust. Flame* **21,** 187-194 (1973).

Key words: $CH_3$; flames; H; mass spectrometry; OH; radicals.

A mass spectrometric system is described for the measurement of reactive intermediates in 1 atm flames. The system has been tested on $CH_4 - O_2$ and $CH_4 - O_2 - N_2$ flames and provides for the first time a complete analysis of such flames for species in excess of $10^{-5}$ mole fraction concentration.

**13673.** Levine, J., Stebbins, R., **Upper limit on the gravitational flux reaching the earth from the Crab pulsar,** *Phys. Rev. D* **5,** No. 7, 1465-1468 (Apr. 1, 1972).

Key words: Crab pulsar; gravitational waves; laser strainmeter; precision interferometry.

A 30-m laser interferometer has been used in a search for gravitational radiation from the Crab pulsar. The minimum detectable signal would be produced by an incident gravitational flux of $10^9$ ergs/sec cm² and we find no effect at this level.

**13674.** Barton, J. A., Jr., Burns, C. L., Chandler, H. H., Bowen, R. L., **An experimental radiopaque composite material,** *J. Dent. Res.* **52,** No. 4, 731-739 (1973).

Key words: Barium glass; dental composites; dental reinforcements; physical properties; resins; silica; x-ray opacity.

Physical properties of a composite material, developed for use as a temporary posterior restorative material, have been investigated. The material is based on isomeric phthalate esters of 2-hydroxyethyl methacrylate and reinforcing fillers consisting of particles of vitreous silica and an x-ray-opaque glass. Properties investigated include hardening time, tensile and compressive strengths, indentation and recovery, hardness, water sorption, solubility, polymerization shrinkage, optical and x-ray opacity, color stability and thermal expansion. All properties were studied using 3 different powder-liquid rations: 1.10, 1.35 and 1.45 Gm of powder to 0.4 ml of monomer, under wet and dry storage conditions. The powder-liquid ratio had little effect on compressive strength; e.g., 1.45 ratios, respectively. The tensile strength of the 1.10 ratio specimens was lower than those of the 1.35 and 1.45 ratio specimens (at six hours, 25.5 as compared to 30.4 MN/m²). Water sorption at one week was 0.2 to 0.3 mg/cm².

**13675.** Shirley, J. H., **Semiclassical theory of saturated absorption in gases,** *Phys. Rev. A* **8,** No. 1, 347-368 (July 1973).

Key words: Gas laser theory; lamb-dip; saturated absorption.

A three-dimensional theory for the resonant interaction of electromagnetic waves with a gas of two-level atoms is formulated in terms of macroscopic variables. The theory is utilized to find the steady-state attenuation of a plane wave in the presence of another plane wave running in the opposite direction with different amplitude. Contributions are included from the reflection of the oppositely running wave by an induced standing-wave inhomogeneity in the population inversion of the medium. The resulting attenuation and reflection coefficients are expressed as velocity integrals of continued fractions. Correspondence is made with existing gas-laser theories, yielding the formulation of a high-intensity ring-laser theory. Analytic approximations for the coefficients are presented for the Doppler-limit cases of both waves weak, one wave weak, and negligible reflection (rate-equation approximation). More-general cases have been calculated numerically. The attenuation coefficients exhibit a Lamb-dip feature. The relative depth of the dip increases rapidly with power at low saturation levels, slowly at high saturation, and is greater in the attenuation of the weaker wave. The width of the dip is nonlinearly power broadened. The shape of the dip is very nearly Lorentzian, except for one special case at high power in which the line splits. The propagation equations for the two waves are integrated over long absorption paths. A large resulting attenuation increases the relative size of the dip while decreasing the power broadening.

13676. Roberts, J. R., Andersen, T., Sørensen, G., **Determination of atomic lifetimes and absolute oscillator strengths for neutral and ionized titanium,** *Nucl. Instrum. Methods* **110,** 119-125 (1973).

Key words: Absolute transition probabilities; arc; beam foil; experimental; lifetimes; titanium.

Measurements of atomic lifetimes by the beam-foil technique and branching ratios by use of a gas-flow stabilized arc have led to an experimental determination of absolute oscillator strengths of Ti II. Some lifetimes of Ti I, Ti III and Ti IV are also presented.

13677. Robertson, A. F., **Tests indicate venting increases smoke from some polymerics,** *Fire Eng.* **126,** No. 9, 97-98 (Sept. 1973).

Key words: Buildings; cellulosics; fires; polymers; smoke; venting.

The problem of voluminous smoke production during burning of plastic or polymeric materials is considered. Experimental data on smoke density resulting from both smouldering and flaming pyrolysis of cellulosic and polymeric sheet and foam materials are presented and compared. It is concluded that in general, although exceptions occur for specific materials, cellulosics produce much less smoke than polymerics under flaming exposure. The smoke production under smouldering exposure is roughly comparable for the two classes of materials. However, the polymeric materials show a marked increase of smoke production for flaming vs. smouldering while the converse is true for cellulosics. It is suggested that the fire fighting ventilation tactics developed and used for fires involving cellulosic materials may aggravate rather than ameliorate the problem of fighting fires involving polymeric materials.

13678. Simmons, J. D., Keller, R. A., **Interferometric effects on the output of organic dye lasers,** *Appl. Opt.* **12,** No. 9, 2033 (Sept. 1973).

Key words: Dye laser continua; high resolution; interferometric effects; optical components; organic dye lasers; wedged optical surfaces.

This note illustrates the necessity of using wedged optical components in organic dye laser systems to avoid interferometric effects.

13679. Fatiadi, A. J., **Mechanism of formation of tris(phenylhydrazones) on treatment of cyclohexane-1,3-diones with phenylhydrazine,** *Chem. Ind.*, pp. 38-40 (Jan. 6, 1973).

Key words: Cyclohexane-1,3-dione; formation; free-radical; ionic; mechanism; phenylhydrazine.

The e.s.r. studies show that the formation of the 2-oxo-1,3-bis(phenylhydrazones) and tris(phenylhydrazones) from cyclohexane-1,3-diones, and of bis(phenylhydrazones) from cyclohexane-1,2-diones, following treatment with phenylhydrazine in polar solvents most likely proceeds by a concerted process, involving both ionic and free-radical pathways.

13680. Stephenson, J. C., **Vibrational energy transfer in NO,** *J. Chem. Phys.* **59,** No. 3, 1523-1527 (Aug. 1, 1973).

Key words: Infrared lasers; laser pumping of molecules; nitric oxide; vibrational energy transfer.

Laser-excited vibrational fluorescence measurements have been used to obtain rate constants at room temperature for vibrational relaxation of the $V=1$ state of NO in collisions with He, Ar, $H_2$, CO, NO, $N_2$, and $CO_2$. Pulses from a $CO_2$ laser, frequency doubled in a tellurium crystal, provided the excitation source. The rate for the $V-V$ exchange $NO(1)+NO(1)\rightarrow NO(0)+NO(2)$ was obtained.

13681. Judd, D. B., Eastman, A. A., **Prediction of target visibility from the colors of target and surround,** *Illum. Eng.* **66,** No. 4, 256-266 (Apr. 1971).

Key words: Color; contrast; detection; tritanopia; visibility; vision.

The target visibilities of each of 266 combinations of target and surround colors have been measured by means of the Eastman contrast-threshold visibility meter. The targets and surrounds were Munsell papers, and the targets were of such size and distance from the observer (AAE) that they subtended 10 minutes of arc. Analysis of these data shows that a modification of the 1964 C1E uniform color space applied to the fluxes leaving target and surround accounts for two-thirds of the observed variation in visibility among the 266 combinations. This modification for 10-minute targets consists of neglecting the violet-greenyellow component of the color differences entirely and of counting the red-green component less than one-tenth that proper for 60-minute targets. By taking into account the fact that the lens system of the human eye, because of chromatic aberration, causes some of the flux leaving the surround to fall on the retinal image of the target, this modified color space has been shown to account for four-fifths of the observed variations in visibility.

13682. Hougen, J. T., **Tabulation of hyperfine splittings in rotational $F_1$ and $F_2$ levels of the ground vibrational state of $^{12}CH_4$, for $J \leq 20$,** *J. Mol. Spectrosc.* **46,** No. 3, 490-501 (June 1973).

Key words: Computer tabulation; ground vibrational state; hyperfine splittings; methane; quantum mechanical Hamiltonian; rotational levels.

To a good approximation, hyperfine splittings for $F_1$ and $F_2$ rotational levels of the ground vibrational state of $^{12}CH_4$ depend linearly on three hyperfine interaction parameters. Coefficients in these linear expressions have been computed in a relatively simple manner and tabulated for levels with $1 \leq J \leq 20$. The hyperfine pattern for the $J=7$ $F_2^{(2)}$ level computed from these expressions using values for the three hyperfine interaction

parameters reported recently by Yi, Ozier and Ramsey [1] agrees well with the pattern obtained from new He-Ne laser measurements of Hall and Bordé [2] on the $P(7)\,F_2^{(2)}$ line of the $\nu_3$ band of methane.

**13683.** Frederikse, H. P. R., Hosler, W. R., **Electrical conductivity of coal slag,** *J. Amer. Ceram. Soc.* **56,** No. 8, 418-419 (Aug. 1973).

Key words: Electrical conductivity; slag; transfer.

The electrical conductivity of natural and synthetic slags (containing 14 to 36 wt% Fe) was measured from 1200 to 1700 K at $O_2$ pressures from 1 to $2 \times 10^{-6}$ atm. The conductivity is relatively high ($\approx 10^{-2}\ \Omega^{-1}\ cm^{-1}$ at 1700 K) and stems from the transfer of electrons between $Fe^{2+}$ and $Fe^{3+}$ ions. Anomalies in the conductivity around 1600 K are the result of devitrification of the glass samples.

**13684.** Dewitt, D. P., Richmond, J. C., **Theory and measurement of the thermal radiation properties of metals,** Chapter 1 in *Measurement of Physical Properties: Some Special Properties,* E. Passaglia, Ed., **VI,** Part 1, 1-90 (Interscience Publ., New York, N.Y., 1972).

Key words: Absorptance; electromagnetic theory; emittance; measurement techniques; metals; reflectance; surface effects; thermal radiation properties.

This is a general review of the thermal radiation properties of metals, and includes (1) description and definition of the properties, and a discussion of their interrelationships, (2) a brief review of the physical laws relating to blackbody radiation, (3) discussion of the theory of the interaction of electromagnetic waves with electrical conductors, (4) the effect of surface condition—profile and surface films— on thermal radiation properties of metals, and (5) a review of methods of measuring thermal radiation properties of metals.

**13685.** Straty, G. C., Younglove, B. A., **Some sound velocity measurements on liquid fluorine,** *J. Chem. Phys.* **58,** No. 5, 2191-2192 (Mar. 1, 1973).

Key words: Compressed liquid; fluorine; saturated liquid; sound velocity.

Some sound velocity measurements on liquid fluorine at 110 K and 130 K at pressures to 21 $MN/m^2$ are reported. Data were acquired prior to a destructive reaction in the cell which prevented further measurements.

**13686.** Fickett, F. R., **Magnetoresistivity of copper and aluminum at cryogenic temperatures,** *(Proc. 4th Int. Conf. on Magnet Technology, Brookhaven National Laboratory, Upton, N.Y., Sept. 19-22, 1972),* pp. 539-541 (Atomic Energy Commission, Washington, D.C., 1972).

Key words: Aluminum; copper; electrical properties; magnetoresistance.

Results of recent measurements of the magnetoresistance of polycrystalline wires of aluminum and copper are presented. The measurements were made in the temperature range 4 K to 35 K and in magnetic fields to 100 kOe. The aluminum wires ranged in purity from RRR = 1000 – 30 000 and the copper wires from RRR = 200 – 7000. RRR = R(273 K)/R(4 K).

**13687.** Becker, D. A., LaFleur, P. D., **Neutron activation analysis: Application to trace element analysis in biological and environmental materials,** *Proc. 5th Annual Conf. on Trace Substances in Environmental Health, University of Missouri, Columbia, Mo., 1971,* pp. 447-453 (1972).

Key words: Biological samples; biological standards; chemical separations; environmental samples; neutron activation analysis (NAA); nondestructive; reagent blanks; trace element analysis.

Neutron activation analysis (NAA) has been found useful for trace element analysis of biological and environmental samples. The favorable characteristics of this technique include high sensitivity, wide applicability, great specificity, and reduced contamination and reagent blank problems. The utilization of this technique for the analysis of several elements (Mn, Na, Cu, Zn, U) in the recently certified NBS Biological Standard Reference Material: Orchard Leaves, is described. Techniques used include both nondestructive analysis and destructive analysis using radiochemical separations. In addition, the analytical results obtained by NAA on the Orchard Leaves, is compared to that obtained by other analytical techniques.

**13688.** Hummer, D. G., Kunasz, C. V., Kunasz, P. B., **Numerical evaluation of the formal solution of radiative transfer problems in spherical geometries,** *Comput. Phys. Commun.* **6,** 38-57 (1973).

Key words: Early-type stars; model atmospheres; radiative transfer; spectral line formation; spherical geometry.

If the source function and opacity are specified numerically on a grid of radius and frequency points in a spherically symmetric atmosphere, the program described here calculates the formal solution of the radiative transfer equation, that is, the intensity of radiation on the corresponding grid, and evaluates the first three angular moments of the radiation field. Extensive use of cubic splines in the analysis has made possible an extremely rapid and compact procedure for this calculation. This program has been used extensively in the solution for line formation problems in spherically symmetric atmospheres.

**13689.** Lovejoy, R. W., Olson, W. B., **Ground state rotational constants for $^{28}SiH_3D$,** *J. Chem. Phys. Letters to Editor* **57,** No. 5, 2224-2225 (Sept. 1, 1972).

Key words: Infrared spectrum; monodeuterosilane; perturbation allowed transitions; rotational constants; stretching vibrations.

The infrared spectrum of the $\nu_1$ and $\nu_4$ stretching vibrations of $SiH_3D$ have been recorded with high resolution. The ground state rotational constants have been determined with much greater precision than has previously been reported. Observed perturbation allowed transitions have also made possible the determination of $A_o$-$B_o5D_o^K$.

**13690.** Field, R. W., Wicke, B. G., Simmons, J. D., Tilford, S. G., **Analysis of perturbations in the $a^3\Pi$ and $A^1\Pi$ states of CO,** *J. Mol. Spectrosc.* **44,** No. 2, 383-399 (Nov. 1972).

Key words: $a^3\Pi$, $A^1\Pi$ states; CO; configuration interaction; electronic perturbation parameters; matrix element; perturbation analysis.

The results of an analysis of perturbation of the CO $a^3\Pi$ and $A^1\Pi$ states of the...$(\pi 2p)^4(\sigma 2p)(\pi^* 2p)$ electronic configuration by states of the ...$(\pi 2p)^3(\sigma 2p)^2(\pi^* 2p)$ configuration provide evidence for the following conclusions: (i) For perturbations between vibronic levels of a given pair of electronic states, the perturbation matrix element is the product of a vibrational factor and a constant electronic factor, (ii) Simple single configuration arguments successfully predict that all the electronic factors for the perturbations between levels of each pair of states can be related to two constants which are joint properties of the two electronic configurations $\sigma\pi^*$ and $\pi^3\pi^*$.

**13691.** Field, R. W., Tilford, S. G., Howard, R. A., Simmons, J. D., **Fine structure and perturbation analysis of the $a^3\Pi$ state of CO,** *J. Mol. Spectrosc.* **44,** No. 2, 347-382 (Nov. 1972).

Key words: $a^3\Pi$ state; CO; electronic spectra; rotational analysis; vibrational analysis.

The Cameron absorption bands of CO($v' = 1 - 8$; $v'' = 0$) have been photographed at high resolution. The analysis of these bands along with a reanalysis of the $a^3\Pi$, $v = 0$ level and an analysis of the perturbations of the $a^3\Pi$ state by levels of the $a'^3\Sigma^+$, $e^3\Sigma^+$, $d^3\Delta_i$ and $I^1\Sigma^-$ states will be presented. Deperturbed molecular constants for the $a^3\Pi$ state and accurate perturbation parameters for the interactions of $a^3\Pi$ with nearby states have been determined by a last-squares matrix diagonalization technique. The input data included: (i) earlier measurements from triplet-triplet emission transitions, (ii) the new measurements of the Cameron bands, (iii) rf measurements of $a^3\Pi$ lambda doubling transitions, and (iv) measurements of absorption to the neighboring perturbing states.

**13692.** Seltzer, S. M., Berger, M. J., Rosenberg, T. J., **Auroral bremsstrahlung at balloon altitudes,** *NASA Spec. Publ. 3081,* 25 pages (National Aeronautics and Space Administration, Washington, D.C., 1973).

Key words: Atmosphere; auroral electrons; balloon experiment; bremsstrahlung; energy spectrum; transport calculation.

Data from a Monte Carlo calculation of the transport of electrons and secondary bremsstrahlung are presented in tabular and graphical form. These data describe bremsstrahlung flux spectra at various atmospheric depths between 3.0g/cm² and 15.0 g/cm² caused by a wide-area uniform precipitation into the atmosphere of electrons with energies between 30 and 2000 keV. The angular distribution of the incident electrons has been assumed to be isotropic over the downward hemisphere. A basic set of results is given for incident monoenergetic electron beams, which can be used to treat incident electron beams with any spectrum of interest. A comprehensive set of results, in the form of differential and integral bremsstrahlung flux spectra, has been obtained for the case of electron beams with exponential energy spectra, for e-folding energies between 5 and 200 keV.

**13693.** Prince, E., Donnay, G., Martin, R. F., **Neutron diffraction refinement of an ordered orthoclase structure,** *Amer. Mineral.* **58,** 500-507 (1973).

Key words: Aluminum silicate; feldspar; neutron refinement; orthoclase, silicate minerals; silicon aluminum ordering.

The crystal structure of a pegmatitic monoclinic potassium feldspar, $(K_{0.86}Na_{0.10}\square_{0.04})$ $(Si_{3.00}Al_{1.00})$ $[O_{7.96}(OH)_{0.04}]$, from the Himalaya mine in the Mesa Grande pegmatite district, Calif., has been refined with 3-dimensional neutron-diffraction data to an unweighted $R$ value of 0.031 for 721 symmetry-independent observed reflections. Atomic coordinates differ by no more than 3 estimated standard deviations from those of Spencer B adularia, yet the specimen does not have the adularia morphology, and no diffuse reflections with $(h + k)$ odd have been observed. Direct refinement of the tetrahedral cation distribution shows that the Al content of the $T(2)$ sites is not significantly different from zero (actually $-0.016$ with an e.s.d. of 0.029); in other words the Al-Si ordering in the tetrahedral sites is essentially complete. The mean Si-O distance in the $T(2)$ sites is 1.616 Å, appreciably greater than the values predicted by various regression lines relating bond distance to aluminum content. This indicates that the observed mean $T_1(m)$-O, $T_2$(O)-O, and $T_2(m)$-O bond lengths reported for low albite and maximum microcline are consistent with full Si occupancy. This ordered orthoclase occurs in gem pockets in a microcline-bearing pegmatite. The association suggests stable growth of ordered orthoclase above the field of stability of microcline and metastable persistence to lower temperatures. Perhaps because of more rapid crystal growth, the bulk of the pegmatitic K-feldspar ordered to common orthoclase, then transformed to maximum microcline.

**13694.** Currie, L. A., **The limit of precision in nuclear and analytical chemistry,** *Nucl. Instrum. Methods* **100,** 387-395 (1972).

Key words: Counting precision; excess variability; limiting precision; photonuclear chemistry; Poisson statistics; single and multiple parameter nuclear analyses; statistical weights; 14 MeV neutron activation.

The precision associated with an experiment in nuclear chemistry or activation analysis is commonly estimated by means of Poisson counting statistics. Such an estimate, as well as the conclusion that the precision may be indefinitely improved by increasing the number of counts obtained, is necessarily wrong when additional sources of random error are operating. Knowledge of the additional, non-Poisson component of random error is required for reliable estimates of parameters and their standard errors, to detect model errors, to plan counting experiments efficiently, and to establish the limit of precision when the Poisson counting error becomes negligible. For these purposes, an iterative computation program—XESS—has been developed to take into account the additional variance and unequal statistical weights. The significance and detectability of excess variance is illustrated with data from studies of photonuclear reactions and activation analysis.

**13695.** Piganiol, M. P., Balke, S., Branscomb, L. M., Hamada, S., Hookway, H. T., Tell, B. V., Ad Hoc Group on Scientific and Technical Information OECD, **INFORMATION for a changing society, some policy considerations,** *Organisation for Economic Co-operation and Development,* 46 pages (OECD Publication, Paris, France, 1971).

Key words: Information packages; information policy; information systems; information users; OECD; technical information.

Early in 1969 the Secretary General of OECD established an Ad Hoc Group on Scientific and Technical Information, requesting the Group to "explore the nature, magnitude, and implications of the needs for scientific and technical information and data in science, the economy and society, and how these needs may be met through changes in the structures, technologies and policies, and management concepts." The Ad Hoc Group reached 13 conclusions and recommendations dealing with the scope of action of OECD, the usefulness and applicability of scientific and technological information systems, quality control of content and procedure of information systems, education for information system needs, and international cooperation. The report describes the observations and arguments leading to the conclusions and recommendations.

**13696.** Myers, V. W., **Klein-Gordon equation for a charged particle interacting with an electromagnetic wave,** *J. Franklin Inst. Brief Commun.* **295,** No. 6, 497-499 (June 1973).

Key words: Expectation values; Klein-Gordon equation; plane electromagnetic wave.

A solution of the two-component Klein-Gordon equation is obtained from a solution of the corresponding one-component equation for the example of a charged particle interacting with a plane electromagnetic wave. Expectation values for momentum components and the total energy of the particle are calculated.

**13697.** Santoro, A., Mighell, A. D., **Properties of crystal lattices: The derivative lattices and their determination,** *Acta Crystallogr.* **A28,** Part 3, 284-287 (May 1972).

Key words: Crystallography; lattices; sub-lattices; superlattices.

Derivative lattices are classified as super, sub and composite, on the basis of the properties of the transformation matrices relating them to the lattice from which they are derived. A method for obtaining the transformation matrices generating these lattices is given. The method has been applied to derivation of the unique super and sublattices in a few important cases.

**13698.** Rowe, J. M., Livingston, R. C., Rush, J. J., **Neutron quasielastic scattering study of $SH^-$ reorientation in the cubic phases of cesium and rubidium hydrosulfide,** *J. Chem. Phys.* **58,** No. 12, 5469-5473 (June 15, 1973).

Key words: Alkali hydrosulfides; hydrosulfide ion; ion reorientation; neutron scattering; phase transition; quasielastic scattering.

The orientational disorder of the hydrosulfide ions in CsSH (CsCl phase) and RbSH (NaCl phase) has been investigated by quasielastic neutron scattering with high energy resolution ($\Delta E_{1/2max}=0.25$ meV). The experimental results provide a clear demonstration of the theoretically predicted separation of the quasielastic neutron peaks for rotating groups or molecules into unbroadened and broadened components which reflect, respectively, the geometric and time behavior of the rotation. Jump reorientation of the ions between equilibrium directions is established as the dominant mechanism creating the rotational disorder in the hydrosulfides, and both small-step rotational diffusion and quasifree rotation are clearly ruled out. Average residence times between reorientation jumps are derived from comparisons of the experimental results with theoretical calculations based on jump reorientation models, but it is not possible to determine the equilibrium orientation of the $SH^-$ ions. Mean-square vibrational amplitudes for the hydrogen atoms are also obtained from the observed integrated intensities of the elastic peaks. The present results are compared in detail with previous lower-resolution neutron results on NaSH and CsSH. It is concluded that in most cases measurements using single crystals will be necessary to establish the details of orientation disorder in solids.

**13699.** Santoro, A., Mighell, A. D., **Coincidence-site lattices,** *Acta Crystallogr.* **A29,** Part 2, 169-175 (Mar. 1973).

Key words: Crystal aggregates; crystals; grain boundaries; lattices; sublattices; superlattices.

Coincidence-site lattices are characterized mathematically, in the general case, by a method that can be applied to a pair of original lattices of any symmetry, either metrically identical or metrically different, does not involve inspection and is readily adaptable to computer calculations. The procedure is illustrated by several numerical examples. The proposed characterization of coincidence-site lattices is based on the theory of derivative lattices and makes extensive use of the concepts of superlattice and sublattice. Appended is a simple procedure for determining the transformation matrices needed to generate superlattices and sublattices of any multiplicity.

**13700.** Rush, J. J., de Graaf, L. A., Livingston, R. C., **Neutron scattering investigation of the rotational dynamics and phase transitions in sodium and cesium hydrosulfides,** *J. Chem. Phys.* **58,** No. 8, 3439-3448 (Apr. 15, 1973).

Key words: Cesium hydrosulfide; hydrosulfides; ion reorientation; libration; neutron scattering; phase transition; quasielastic; residence time; sodium hydrosulfide.

The rotational motions of the hydrosulfide ions in the trigonal and fcc phases of NaSH and in the pseudo-bcc (CsCl) phase of CsSH have been studied by quasielastic and inelastic neutron scattering. NaSH and CsSH are members of a broad group of compounds $M^+(XY^-)$ which have cubic symmetry in the solid phase just below the melting point and a lower symmetry in lower temperature crystal phases. The measured inelastic neutron spectra above and below the trigonal to cubic phase transition in NaSH show that $SH^-$ ion "librations" about equilibrium orientations persist in passing through the transition. The maximum of the broad librational bands for both NaSH and CsSH occurs near 400 $cm^{-1}$. A temperature and momentum-transfer ($Q$) dependent broadening is observed, however, in the quasielastic peaks in the cubic phases of the hydrosulfides, which indicates a rapid reorientation of the $SH^-$ ions. The experimental quasielastic scattering results are compared with theoretical calculations of quasielastic scattering behavior based on the assumption of instantaneous reorientational jumps between a limited number of quasiequilibrium orientations. The widths of the measured quasielastic peaks plotted vs $Q$ show an oscillatory behavior as predicted by the theoretical calculations. An isotropic reorientation model is ruled out, and the differences in the rotational disorder in NaSH and CsSH are discussed. Relaxation times ($\tau$) for the $SH^-$ motions are derived from the theoretical analysis. The $\tau$ values for fcc NaSH vary from 0.4 to 0.15 psec between 103 and 212 °C, while the values for pseudo-bcc CsSH vary from 2.0 to 0.75 psec between 23 and 140 °C.

**13701.** Siu, M. C. 1., **Equations for thermal transpiration,** *J. Vac. Sci. Technol.* **10,** No. 2, 368-372 (Mar./Apr. 1973).

Key words: Anomalous Knudsen limit; diffuse scattering; irreversible thermodynamics; specular scattering; thermal transpiration.

A formalism for analytically obtaining an expression for the thermal transpiration pressure ratio $R$ is presented. An experimental parameter $\sigma$, which is associated with the type of molecule-solid surface collisions, is introduced. A completely diffuse scattering and a completely specular scattering from a solid surface correspond to $\sigma=0$ and $\sigma=1$, respectively. A known distribution function is used to derive a practical formula for $R$ in the case of long tubes and very low pressures. Quantitative results obtained from this formula indicate that deviations from completely diffuse scattering of molecules from solid surfaces give rise to an anomalous Knudsen limit.

**13702.** Petersen, F. R., McDonald, D. G., Cupp, J. D., Danielson, B. L., **Rotational constants for $_{12}C_{16}O_2$ from beats between Lamb-dip-stabilized lasers,** *Phys. Rev. Lett.* **31,** No. 9, 573-576 (Aug. 27, 1973).

Key words: Accurate rotational constants; carbon dioxide ($^{12}C^{16}O_2$); Josephson junction; Lamb-dip-stabilized lasers.

New experimental measurements of the frequency separations of 30 pairs of $^{12}C^{16}O_2$ laser lines in the 10.4-$\mu$m band and 26 pairs in the 9.4-$\mu$m band have been made with Lamb-dip-stabilized lasers. The use of a Josephson junction as the frequency-mixing element simplified the measurements. Uncertainties in existing rotational constants for the laser vibrational levels were reduced 20 to 30 times and an additional rotational constant $H_v$ was determined for the first time.

**13703.** Sugar, J., Reader, J., **Ionization energies of doubly and triply ionized rare earths,** *J. Chem. Phys.* **59,** No. 4, 2083-2089 (Aug. 15, 1973).

Key words: Cerium; dysprosium; erbium; europium; gadolinium; hafnium; holmium; ionization energy; lanthanum; lutetium; neodymium; praseodymium; promethium; samarium; terbium; thulium; ytterbium.

Values for the ionization energies of the doubly and triply ionized rare earth atoms have been derived from interpolated spectroscopic properties of the $4f^Ns$ series, and from interpo-

lated energy intervals relating the first series member, $4f^N6s$, to the ground state. The results in eV are

| | | |
|---|---|---|
| Tb III | 21.91(10) | IV 39.79(20) |
| Dy | 22.79(30) | 41.47(20) |
| Ho | 22.84(10) | 42.48(32) |
| Er | 22.74(10) | 42.65(21) |
| Tm | 23.68(10) | 42.69(20) |
| Yb | 25.03(2) | 43.74(20) |
| Lu | 20.9596(10) | 45.19(2) |
| Hf | | 33.33(2) |
| La III | 19.1774(6) | |
| Ce | 20.198(3) | IV 36.758(5) |
| Pr | 21.624(3) | 38.98(2) |
| Nd | 22.14(30) | 40.41(20) |
| Pm | 22.32(36) | 41.09(32) |
| Sm | 23.43(30) | 41.37(38) |
| Eu | 24.70(32) | 42.65(32) |
| Gd | 20.63(10) | 44.01(35) |

The values for the doubly ionized atoms agree to witnin ~ 1 percent with those deduced from thermodynamic measurements on lanthanide oxides. A value for the ionization energy of Gd II of 12.09(8) eV was determined by using new spectroscopic data for Gd II Gd III.

**13704.** Flynn, J. H., **Instrumental limitations upon the measurement of temperature and rate of energy production by differential scanning calorimetry,** (Proc. 3d Int. Conf. on Thermal Analysis, Davos, Switzerland, Aug. 23-28, 1971), Paper in *Thermal Analysis,* H. G. Wiedemann, Ed. **1,** 127-138 (Birkhäuser Verlag, Basel, Switzerland, 1972).

Key words: Cooling curve temperature calibration; differential scanning calorimetry; evaluation of thermal apparatus; temperature calibration; thermal analysis.

Instrumental time constants for rate of energy production response, temperature-programming response and temperature-averaging network response, time constants for a wide variety of conditions for interfacial conductivity between the sample and the calorimeter cup, and for the thermal conductivity of the sample are catalogued for the differential scanning calorimeter. Assessment of the effects of these factors upon the net rate of power production sensitivity and the temperature calibration results in the establishment of limits of precision in the measurement of temperature, specific heat and heats and rates of enthalpy change during chemical and physical transformations. The vulnerability of these calibrations to instrumental readjustment and variation in experimental techniques is also quantitatively evaluated.

**13705.** Milligan, D. E., Jacox, M. E., Guillory, W. A., **Infrared spectrum on the $NO_2^-$ ion isolated in an argon matrix,** *J. Chem. Phys.* **52,** No. 8, 3864-3868 (Apr. 15, 1970).

Key words: Alkali metal reactions; electron attachment; infrared spectrum; matrix isolation; $NO_2^-$; photodetachment; photoionization.

The molecular ion $NO_2^-$ has been stabilized in an argon matrix in sufficient concentration for detection of its antisymmetric stretching fundamental, $\nu_3$, at 1244 $cm^{-1}$ by electron bombardment or photoionization of matrix-isolated $NO_2$ and by the interaction of an alkali-metal atomic beam with $NO_2$ in an argon matrix. In contrast to the position of this fundamental in an inert, nonionic environment, a value of approximately 1275 $cm^{-1}$ is characteristic of the crystalline material. Isotopic data are consistent with a 115° valence angle for $NO_2^-$, independent of environment. Irradiation of the sample with light of wavelength near 3150 Å leads to the destruction of the $NO_2^-$ absorption in the studies of the electron bombardment and photoionization of $NO_2$, but not in the experiments in which the alkali metal atoms provide a reservoir of photoelectrons.

**13706.** Milligan, D. E., Jacox, M. E., **Infrared and ultraviolet spectroscopic studies of a number of small free radicals and molecular ions in a matrix environment,** (Proc. Symp. on Spectroscopic Methods in Cryochemistry and of the Chemistry of High Temperature Species, Minneapolis, Minn., Apr. 1969), Paper in *Advances in High Temperature Chemistry,* Leroy Eyring, Ed. **4,** 1-42 (Academic Press, Inc., New York, N.Y., 1971).

Key words: Free radicals; infrared spectrum; matrix isolation; molecular ions; photolysis; ultraviolet spectrum.

The development of the matrix isolation technique is summarized, and the principles which have been found to be important for the *in situ* photoproduction of free radicals trapped in inert solid matrices in sufficient concentration for direct infrared and ultraviolet spectroscopic observation are considered. A survey of the small free radical species heretofore studied using these techniques is given. Examples of the successful application of the technique are drawn from recent studies of the vacuum-ultraviolet photolysis of matrix-isolated methane and silane and of their chloro- and fluoro-derivatives. Results of experiments designed to permit the trapping in inert, nonionic matrices of negatively charged molecular ions are presented.

**13707.** Finnegan, T. F., Witt, T. J., Field, B. F., Toots, J., **Measurements of $2e/h$ via the AC Josephson effect.** (Proc. 4th Int. Conf. on Atomic Masses and Fundamental Constants, Teddington, England, Sept. 6-10, 1971), Paper in *Atomic Masses and Fundamental Constants* **4,** J. H. Sanders and A. H. Wapstra, Eds., pp. 403-410 (Plenum Press, New York, N.Y., 1972).

Key words: Josephson junction; standard cell; voltage comparison.

Recent sub-part-per-million determinations of $2e/h$ have been reported by several groups. The accuracies of these determinations have been limited to a large extent by uncertainties in the local voltage standard (i.e., standard cells). The present state of agreement between the various $2e/h$ determinations will be reviewed by using the results of the triennial international volt comparisons at BIPM, as well as the results of direct volt comparisons between NBS and other national laboratories, to relate the various national as-maintained units of voltage.

Progress on the NBS project to maintain a unit of emf via a Josephson junction device will also be reported. The results of a series of $2e/h$ measurements made at the site of the NBS reference group of standard cells will be presented. The implications of these measurements on the stability of the NBS reference group of standard cells, and on the fundamental physical constants (i.e., the fine structure constant) will be discussed.

**13708.** Nelson, J. D., Blair, W., Brinckman, F. E., Colwell, R. R., Iverson, W. P., **Biodegradation of phenylmercuric acetate by mercury-resistant bacteria,** *Appl. Microbiol.* **26,** No. 3, 321-326 (Sept. 1973).

Key words: Atomic absorption; biodegradation; mercury-resistant bacteria; mercury transformations; phenylmercuric acetate, Pseudomonas.

Selected cultures of mercury-resistant bacteria degrade the fungicide-slimicide phenylmercuric acetate. By means of a closed system incorporating a flameless atomic absorption spectrophotometer and a vapor phase chromatograph, it was demonstrated that elemental mercury vapor and benzene were products of phenylmercuric acetate degradation.

**13709.** Falge, R. L., Jr., Swartzendruber, L. J., **Influence of clustering on the paramagnetic behavior of a Cu-Ni alloy,** *Phys. Lett.* **44A,** No. 4, 285-286 (June 18, 1973).

Key words: Clustering; critical phenomena; Cu-Ni alloy; heat treatment; magnetism; susceptibility.

The equation usually reserved for the critical behavior of a ferromagnet just above $T_c$ also describes the susceptibility of $Cu_{0.47}Ni_{0.53}$ over a very large temperature range. The parameters, which vary with heat treatment suggest lamellar clustering.

**13710.** Miller, G., **The Shirley Highway Express-Bus-on Freeway demonstration project—Project description,** *Report DOT/UM-TA* **1,** 87 pages (Urban Mass Transportation Administration, Department of Transportation, Washington, D.C., Aug. 1971). (Available as PB 218983 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Bus fringe parking; bus priority lanes, bus priority lanes in District of Columbia; bus transit operation; exclusive bus lanes, express-bus-on freeway technology; Shirley Highway Corridor in Northern Virginia; Urban Mass Transit Demonstration Project.

This report describes the three major demonstration project elements: (1) the busway, including the exclusive lane on Shirley Highway and the bus priority lanes in the District; (2) the bus transit operation, involving new buses (with special features) on new routes and schedules; and (3) the residential fringe parking, with shopping centers and new lots providing free parking for bus riders. The existing roadway and bus operations are documented and the improvements planned for 1971-72 are presented. The Shirley Highway Corridor where the bus and auto commuters live is described, as is the major employment destination areas. Data are also presented on bus and auto travel volumes for 1970-1971, before the busway was completed and the new buses placed into operation.

**13711.** Wiederhorn, S. M., **Environmental stress corrosion cracking of glass,** (Proc. Int. Conf. on Corrosion Fatigue, Chemistry, Mechanics and Microstructure, University of Connecticut, Storrs, Conn., June 14-18, 1971). Paper in *Corrosion Fatigue,* **NACE-2,** 731-742 (National Association of Corrosion Engineers, Houston, Texas, 1972).

Key words: Cracked propagation of glass; glass; glass fibers; hardness of glass; static fatigue of glass; strength of glass; stress corrosion cracking of glass; structure of glass.

A review is presented on the effect of environment on the strength of glass. The structure of glass and its strength in the absence of environment are discussed briefly. Experimental results on environmental cracking of glass are presented. Finally, theroretical treatments are given and discussed with respect to available experimental data.

**13712.** Etz, E. S., Robinson, R. A., Bates, R. G., **Dissociation constant of protonated tris(hydroxymethyl)aminomethane in N-methylpropionamide and related thermodynamic quantities from 10 to 55 °C,** *J. Solution Chem.* **2,** No. 4, 405-415 (1973).

Key words: Acidic dissociation; dissociation constant; emf measurements; ionization processes; N-methylpropionamide; solvation; tris(hydroxymethyl)aminomethane.

The dissociation constant of protonated tris(hydroxymethyl)aminomethane (tris $H^+$) in the solvent *N*-methylpropionamide (*NMP*) has been determined at intervals of 5 °C from 10 to 55 °C by measurement of the emf of cells without liquid junction using hydrogen and silver-silver chloride electrodes. At 25 °C, $pK_a$ was found to be 8.831, as compared with 8.075 in water. The standard changes in Gibbs energy, enthalpy, and entropy for the dissociation process have been evaluated from the dissociation constant and its change with temperature. By comparison with similar data for the dissociation of tris · $H^+$ in water, thermodynamic functions for the transfer from water to *NMP* have been derived. The dissociation process is isoelectric, and the solvent dielectric constant is high ($\epsilon = 176$ at 25 °C). Consequently, electrostatic charging effects are expected to be minimal, and the change in dissociation constant depends primarily on solute-solvent interactions. The results, combined with transfer energies for *HCl*, tris, and tris · *HCl* from emf and solubility measurements, demonstrate that the decreased acidic strength of tris · $H^+$ in *NMP* is attributable in large part to the fact that *NMP* is less effective than water in stabilizing tris and its salts.

**13713.** Unassigned.

**13714.** Baker, M. A., **Observing porcelain enamels with a scanning electron microscope,** *Proc. Porcelain Enamel Institute Technical Forum, The Ohio State University, Columbus, Ohio, Oct. 6-8, 1971,* **33,** 84-90 (Porcelain Enamel Institute, Inc., Washington, D.C., 1971).

Key words: Corrosion; pinhole-type defects; porcelain enamel; scanning electron microscope; weathering tests; non-dispersive x-ray spectrometer.

Porcelain enamel surfaces and enamel-metal interfaces have been observed with a scanning electron microscope. The increased depth of field and the extended range of magnifications of the scanning electron microscope were utilized in studies of the enamel-metal interface and of weathering test specimens that corroded after relatively short periods of exposure. The non-dispersive x-ray spectrometer accessory for the scanning electron microscope was used to determine the elements present in the enamel surface and to obtain qualitative distributions of these elements.

**13715.** Baker, M. A., **Weathering tests of porcelain enamels on steel and aluminum,** *Proc. Porcelain Enamel Institute Technical Forum, The University of Illinois, Urbana, Ill., Oct. 11-13, 1972,* **34,** 186-198 (Porcelain Enamel Institute, Inc., Washington, D.C., 1972).

Key words: Accelerated tests; acid resistance; aluminum; color; gloss; porcelain enamel; steel; weather resistance.

The Porcelain Enamel Institute and the National Bureau of Standards have been conducting weathering tests of porcelain enamels since 1939. The four tests now in progress contain matte and glossy porcelain enamels on both steel and aluminum. When the data obtained from these weathering tests were compared with accelerated test data on laboratory specimens, an excellent correlation was found. It was also found that the enamels in all four tests changed gloss and color in practically the same manner.

**13716.** Dibeler, V. H., Walker, J. A., McCulloh, K. E., **Observations on hot bands in the molecular and dissociative photoionization of acetylene and the heat of formation of the ethynyl ion,** *J. Chem. Phys.* **59,** No. 5, 2264-2268 (Sept. 1, 1973).

Key words: Ethynyl ion; heat of formation; ionization threshold; mass spectrometry; vacuum ultraviolet.

Photoion yield curves in the vicinity of threshold are obtained for the molecular and the ethynyl ions of acetylene and acetylene-$d_2$ at ion source temperatures of 360, 298, and 130 K. Weak ionization below the adiabatic threshold for $C_2H_2^+$ and $C_2D_2^+$ is ascribed to the ionization of molecules excited by one quantum of the bending vibrations, $\nu_4$ and $\nu_5$. Consideration of selection rules suggests a change in symmetry from the linear

ground state molecule to a bent ground state ion. The 0 K curves for $C_2H^+$ and $C_2D^+$ are estimated from the observed 130 K data. Satisfactory agreement is obtained when the 298 K data are compared with a curve calculated from the 0 K curve by convolution with vibrational and rotational distributions. The 0 K thresholds corrected for kinetic energy are used to calculate $\Delta Hf°_0(C_2H^+) = 17.47 \pm 0.01$ eV ($402.8 \pm 0.2$ kcal mol$^{-1}$) and $\Delta Hf°_0(C_2D^+) = 17.43 \pm 0.02$ eV ($402.0 \pm 0.5$ kcal mol$^{-1}$). The ionization energy of the ethynyl radical is estimated to be $11.96 \pm 0.05$ eV.

**13717.** Bur, A. J., **Dielectric properties of fluorine-containing polymers,** Chapter 15 in *Fluoropolymers,* L. A. Wall, Ed., **25,** 475-505 (John Wiley-Interscience, New York, N.Y., 1972).

Key words: Dielectric constant; dielectric loss; fluoropolymer; relaxation phenomena; review.

The dielectric properties of polytetrafluorethylene, polychorotrifluoroethylene, polyvinylidene fluoride, and fluorinated ethylene propylene copolymer are reviewed. Relaxation phenomena as a function of temperature and crystallinity is emphasized. Molecular interpretations of the data are discussed. The effects of humidity changes on the dielectric properties of polytetrafluoroethylene and fluorinated ethylene-propylene copolymer show that these polymers are insensitive to humidity changes. Eighty references are cited.

**13718.** Abrams, M. D., **Remote computing: The administrative side,** *Comput. Decisions,* pp. 42-46 (Oct. 1973).

Key words: Administration; batch; computing; documentation; remote; service; users.

The administration and management of remote computing services are discussed with the objective of making both users and administrators aware of the potential problems. Likely difficulties are anticipated and coupled with discussions of assistance, operation, documentation and other features which make it more possible to utilize the technical services. The response to technical questions is covered in terms of written, on-line, and direct contact assistance. A question and answer organization is employed.

**13719.** Krauss, M., Julienne, P. S., **Dissociative recombination of $e + CH^+ (X\ ^1\Sigma^+)$,** *Astrophys. J.,* **183,** L139-L141 (Aug. 1, 1973).

Key words: CH, $CH^+$; dielectronic recombination; electron-ion recombination; energy curve; Rydberg excited state; valence excited state.

The ratio of the dissociative recombination rate for $e + CH^+$ to the dielectronic recombination rate is calculated to be of the order of $10^3$. These rates place a serious constraint on homogeneous gas-phase production of interstellar $CH^+$ and CH from ground-state atoms.

**13720.** Mielenz, K. D., Eckerle, K. L., Madden, R. P., Reader, J., **New reference spectrophotometer,** *Appl. Opt.* **12,** No. 7, 1630-1641 (July 1973).

Key words: Beam geometry; high accuracy; optical design; spectrophotometer; systematic errors; transmittance.

A new single beam spectrophotometer is described in which transmittance is measured by placing samples normal to a parallel beam of light. Collimation and focusing of the main beam are achieved by means of off-axis parabolic mirrors. The wavelength at which the transmittance is to be measured is selected by a plane grating monochromator having off-axis parabolic mirrors and circular holes as entrance and exit apertures. The instrument has an inherent *accuracy* estimated to be 0.0001 transmittance unit. Its *precision* is characterized by a repeatability of 0.00004 transmittance units for neutral-density filters with transmittances between 10 and 30 percent. The design philosophy used to achieve these results is presented. A discussion of some systematic errors commonly neglected in routine spectrophotometric measurements is given. Systematic errors such as detector nonlinearity and stray radiant energy are measured.

**13721.** Collins, R. C., Haller, W., **Protein-sodium dodecyl sulfate complexes: Determination of molecular weight, size and shape by controlled pore glass chromatography,** *Anal. Biochem.* **54,** 47-53 (1973).

Key words: Chromatography; controlled pore glass; molecular size; porous glass chromatography; protein; protein-sodium dodecyl sulfate complexes; sodium dodecyl sulfate-complexes.

The peak position vs log molecular weight curves of protein-SDS complexes chromatographed on controlled pore glass of narrow pore size distribution is linear over a molecular weight range of 17,000-385,000. A glass with a pore size of approximately 500 Å allows the inclusion of all complexes in this range. Peak position curves on glasses with broad pore distributions show decreased resolution and deviate from linearity at low elution coefficients.

Exclusion size analysis of the elution coefficients of individual complexes from different columns with pore diameters ranging from 197 to 650 Å gives from 120 to 423 Å as their longest dimension. Assuming constant hydration and SDS-to-protein ration, the found dimension suggests the shape of a football, rather than a sphere or rigid rod.

**13722.** Fuller, E. G., **Photonuclear Physics 1973. Where we are and how we got there,** (Proc. Int. Conf. on Photonuclear Reactions and Applications, Pacific Grove, Calif., Mar. 26-30, 1973), Paper in *International Conference on Photonuclear Reactions and Applications,* B. L. Berman, Ed., pp. 1201-1224 (Ernest O. Lawrence Livermore Laboratory, University of California, Livermore, Calif., 1973). (Available as CONF-730301 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Data; experimental facilities; history; photonuclear reactions; research programs; survey.

A brief history is presented of the study of photonuclear reactions from the time of the first measurements in 1934 through the most recent measurements in 1972 and early 1973. Trends are indicated both for the specific types of measurements carried out, as well as for the geographic areas of the world active in the field. A review is given of the data obtained since 1955 as a function of element and isotope and the areas where data are missing are pointed out. Finally, the results of a survey made in early 1973 are given. This survey covered the existing experimental facilities, as well as the research programs directed toward the study of the interaction of electromagnetic radiation with nuclei.

**13723.** Hallowell, P. L., Bertozzi, W., Heisenberg, J., Kowalski, S., Maruyama, X., Sargent, C. P., Turchinetz, W., Williamson, C. F., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electron scattering from $^{19}F$ and $^{40}Ca$,** *Phys. Rev. C* **7,** No. 4, 1396-1409 (Apr. 1973).

Key words: Electron scattering; inelastic; $^{19}F$; $^{40}Ca$; transition strengths.

Electron scattering form factors were measured for the low-lying levels of $^{19}F$ and $^{40}Ca$ for momentum transfers between 0.55 and 1.00 fm$^{-1}$. Elastic scattering from $^{19}F$ yields an rms charge radius of $2.885 \pm 0.015$ fm. Transition strengths and transition radii are obtained for the lowest $5/2^+$, $5/2^-$, and $3/2^+$ states in $^{19}F$. A deformed rotational model gives a very good fit to the form factors for the positive-parity levels with ground-

state deformation parameters of $\beta_2 = 0.41$ and $\beta_4 = 0.17$. The form factors for excitation of the $3^-$ and $2^+$ states in $^{40}Ca$ are analyzed by phase-shift analysis, and transition strengths and transition radii are also obtained for these levels.

**13724.** Martin, W. C., Sugar, J., **Classifications of the resonance lines of europium III**, *Astrophys. J.* **184**, 671-674 (Sept. 1, 1973).

Key words: Atomic ions; atomic spectra; classified lines; energy levels; europium; ionization energy; stellar spectra.

A first analysis of Eu III by Russell *et al.* in 1941 yielded classifications of seven lines (2350-2523 Å) as transitions from the $4f^7\ ^8S^0_{7/2}$ ground level to upper levels identified only as belonging to the $4f^6\ 5d$ configuration. We have diagonalized a truncated energy matrix for $4f^6(^7F)5d$, using parameter values appropriate for Eu III. Comparison of the results with available data for the lines allows identifications of the seven experimental upper levels. These show that the seven lines include the three lines of the basic $4f^7\ ^8S^0 - 4f^6(^7F)5d^8P$ multiplet, the strongest resonance lines of Eu III, and account for most of the oscillator strength of the $4f^7\ ^8S^0 - 4f^6\ 5d$ group.

**13725.** Broadhurst, M. G., Malmberg, C. G., Mopsik, F. I., Harris, W. P., **Piezo- and pyroelectricity in polymer electrets**, (Proc. Conf. on Electrets, Charge Storage and Transport in Dielectrics, Miami Beach, Fla., Oct. 8-13, 1972), Paper in *Electrets, Charge Storage and Transport in Dielectrics*, M. M. Perlman, Ed., pp. 492-504 (The Electrochemical Society, Inc., Princeton, N.J., 1973). (Available as AD 758730 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Electret; piezoelectric; polymer electret; poly(vinyl chloride); pyroelectric.

A model for a polymer electret, based on an elastically isotropic solid with orientationally frozen molecular dipoles, was developed and tested experimentally. This electret is shown to be both piezoelectric and pyroelectric. The polarization is shown to change with mechanically and thermally induced strains in the polarization direction. The currents generated by the electret will be proportional to the strain rate and, for thin contact electrodes and uniform strains, unaffected by the presence of real charges. Poly(vinyl chloride) films were poled at 80 °C, just above their glass transition temperature. The pressure- and temperature-induced short-circuit currents in the polarization direction equalled 0.15 $(pA/cm^2)/(bar/min)$ and 2.2 $(pA/cm^2)/(K/min)$ respectively for a specimen poled at 320 kV/cm. These currents were 1) reversible and proportional to the rate of temperature or pressure change, 2) proportional to poling voltage up to 320 kV/cm, 3) in the direction corresponding to increasing polarization with increasing pressure and decreasing temperature, 4) stable with time without special storage conditions, 5) about 1.6 times as great for temperature induced strains as for equivalent pressure induced strains and 6) about 2-4 times as great in magnitude as expected from dielectric constant measurements. The apparent polarization from temperature measurements for the 320 kV/cm specimen was about 1.7 $\mu C/cm^2$, or about 1/3 the value expected for maximum alignment of dipoles. In the same specimen the pyroelectric coefficient was found to be $p_3 = -0.39\ nC/cm^2\ K$ and, assuming elastic isotropy, the piezoelectric strain coefficients were found to be $d_{31} = d_{32} = d_{33} = -0.89\ pC/N$.

**13726.** Blomquist, D. S., **An experimental investigation of foam windscreens**, (Proc. 1973 International Noise Control Engineering Conference, Copenhagen, Denmark, Aug. 22-24, 1973), Paper in *Inter-Noise 73 Proceedings*, O. J. Pedersen, Ed., pp. 589-593 (Inter-Noise 73, Technical University, Lyngby, Denmark, 1973).

Key words: Acoustic attenuation; foam windscreens; wind-generated noise.

The amount of reduction in wind-generated noise and the amount of acoustic attenuation of the signal as a function of frequency for four different pore sizes and various diameters of open-cell polyurethane foam windscreens is presented.

**13727.** Leasure, W. A., Jr., Bender, E. K., **Tire-road interaction noise**, (Proc. 1973 International Noise Control Engineering Conference, Copenhagen, Denmark, Aug. 22-24, 1973), Paper in *Inter-Noise 73 Proceedings*, O. J. Pedersen, Ed., pp. 421-425 (Inter-Noise 73, Technical University, Lyngby, Denmark, 1973).

Key words: Acoustics; noise (sound); tire noise; transportation noise.

The important parameters influencing tire noise are discussed and the basic mechanisms of tire-noise generation are briefly described from a theoretical viewpoint. Areas for future research are identified—based on gaps in the existing data base and a rather primitive level of understanding of tire noise-generating mechanisms.

**13728.** Blomquist, D. S., Leasure, W. A., Jr., **An hourly noise exposure meter**, (Proc. 1973 International Noise Control Engineering Conference, Copenhagen, Denmark, Aug. 22-24, 1973), Paper in *Inter-Noise 73 Proceedings*, O. J. Pedersen, Ed., pp. 67-69 (Inter-Noise 73, Technical University, Lyngby, Denmark, 1973).

Key words: Acoustics (sound); environmental acoustics; instrumentation; noise exposure.

An instrument has been designed which provides information regarding the average noise exposure over each hour rather than simply a singly measure of noise exposure over an 8-hour work period. The theory of operation and examples of practical measurements utilizing this device will be discussed in the verbal presentation.

**13729.** Benzinger, T. H., **A new concept in thermodynamics and its implication in molecular biology and pharmacology**, Chapter 14 in *Methods in Pharmacology* **2**, Part 2, 481-488 (Appleton-Century Crofts, New York, N.Y., 1972).

Key words: Characteristic function (Planck); chemical bonding energy; double helix; heat integrals; molecular biology; thermal free energy; thermodynamics.

An extended statement of chemical equilibrium of the integral $T\int_0^T (\Delta Cp/T)dT (= T\Delta S_T^\circ)$ and $\Delta H_T^\circ$—the classical terms of the equation $-RTlnK = \Delta H_T^\circ - T\Delta S_T^\circ$. The integral $\int_0^T \Delta CpdT$ is not negligible for macromolecules and particularly biopolymers, and its direct experimental determination at all temperatures down to 0 K is therefore indispensable for thermodynamic understanding of the objects of molecular biology.

**13730.** Chignell, C. F., Benzinger, T. H., **Heatburst microcalorimetry**, Chapter 14 in *Methods in Pharmacology* **2**, Part 1, 465-489 (Appleton-Century Crofts, New York, N.Y., 1972).

Key words: Adenosinetriphosphate-thermodynamics; chemical bond energy; coiled helix thermopiles; drug receptor complexing; entropy; enzyme detection+analysis; equilibrium; free energy; free entropy concept; heat of reaction; heatburst principle; hydrogen bonding; immunoreaction calorimetry; microcalorimetry; molecular biology;

pharmacology; protein calorimetry; polynucleotide calorimetry; purity assay; reaction coupling; thermodynamics; warfarin.

In this chapter the heatburst principle will be briefly discussed followed by a description of the construction and operation of the heatburst microcalorimeter. In the next section, it will be shown how heat can not only be used as an indicator for chemical or biochemical change but can also be used to derive thermodynamic data for the system under study. In a third section, some further possible applications of heatburst microcalorimetry to current problems in molecular biology and pharmacology will be suggested. In a separate section, following this article, the classical determination of the laws of chemical equilibrium and the driving energies of chemical change will be re-examined, and a new determination, more suited to the objects of molecular biology and pharmacology, will be derived.

**13731.** Newbury, D. E., Yakowitz, H., Myklebust, R. L., **Monte Carlo calculations of magnetic contrast from cubic materials in the scanning electron microscope,** *Appl. Phys. Lett.* **23,** No. 8, 488-490 (Oct. 15, 1973).

Key words: Contrast mechanism; electron backscattering energy filtering; iron; magnetic domains; Monte Carlo methods; scanning electron microscopy; transformer steel.

Monte Carlo calculations confirm that contrast observed in the scanning electron microscope from magnetic domains in materials of cubic anisotropy is due to the alteration of electron trajectories within the specimen. Results are presented for the effects of electron accelerating potential, specimen tilt, and rotation. The contrast arises mainly from the high-energy portion of the back-scattered electron distribution.

**13732.** Quindry, T. L., Flynn, D. R., **On a simplified field measurement of noise reduction between spaces,** (Proc. 1973 International Noise Control Engineering Conference, Copenhagen, Denmark, Aug. 22-24, 1973), Paper in *Inter-Noise 73 Proceedings,* O. J. Pedersen, Ed., pp. 199-207 (Inter-Noise 73, Technical University, Lyngby, Denmark, 1973).

Key words: Absorption coefficient; acoustics; airborne sound insulation index; frequency; noise reduction; transmission loss.

This paper investigates the relationships between ratings based on the 1/3-octave band data and more easily obtained ratings of isolation based on A-weighted or C-weighted sound level data. The effects of the source room sound power spectrum, source and receive room absorptions and other parameters on the correlation obtained are discussed.

**13733.** Brenner, F. C., Kondo, A., Cohen, G. B., **Research for a uniform quality grading system for tires V. Effect of environment on tread wear rate,** *Rubber Chem. Technol.* **44,** No. 4, 952-959 (Sept. 1971).

Key words: Automobile tires; environmental effects; test method; tread wear.

This paper is a continuation of work reported in *Rubber Chem. Tech.* **44,** (1971). The results of an additional tread wear test are reported. This and the earlier data are analyzed to determine environmental effects on rate of tread wear.

For all types of commercial passenger car tires our test results support the thesis that the rate of wear on the tire is independent of the extent of wear. Our results also indicated that the rate of tread wear is greater on wet pavements than on dry. An explanation for this phenomenon is discussed.

**13734.** Miller, G. K., Goodman, K. M., **The Shirley Highway Express-Bus-on Freeway demonstration project—first year results,** *DOT/UMTA* **2,** 120 pages (Urban Mass Transportation Administration, Department of Transportation, Washington, D.C., Nov. 1972). (Available as PB 214333 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Bus fringe parking; bus priority lanes; bus priority lanes in District of Columbia; bus transit operation; exclusive bus lanes; express-bus-on-freeway technology; Shirley Highway Corridor in Northern Virginia; urban mass transit demonstration project.

The purpose of the Shirley Highway Express-Bus-On exclusive freeway lane demonstration project is to determine the effectiveness of this technology in easing urban traffic congestion and improving the urban environment. This project, jointly sponsored by the Urban Mass Transportation Administration and the Federal Highway Administration, Department of Transportation, is comprised of three elements—exclusive bus lanes, new feature buses, and park-ride lots coordinated with the express bus service.

The objectives of this demonstration project are: (1) Determine the magnitude of the modal shift (auto-to-bus) in the Shirley Highway Corridor and develop an effective planning tool that may be used to transfer the knowledge gained from the Bus-on-Freeway experiment to other geographic areas; (2) Promote economic viability of transit operation; (3) Reduce traffic congestion during peak periods; (4) Increase people-moving efficiency of Shirley Highway; (5) Reduce vehicle-related air pollution; (6) Reduce travel times for motorists and transit users; (7) Improve reliability of transit service; (8) Increase perceived value of transit; and (9) Improve mobility of young, old, physically handicapped, and low income travelers.

The Technical Analysis Division, National Bureau of Standards is evaluating the demonstration project by monitoring performance in terms of attaining the project objectives, and by determining the contributions of project features to increases in the percentage of commuter trips by bus.

This report presents the results of the evaluation at the end of the first eighteen month period (June 1972) of this multi-year demonstration project.

**13735.** Hord, J., **Cavitation in liquid cryogens. III—Ogives,** *NASA CR-2242,* 235 pages (National Aeronautics and Space Administration, Washington, D.C., May 1973).

Key words: Cavitation; cryogenics; hydrofoil; nucleation; ogives; pumps; venturi.

This document constitutes the third of four volumes to be issued on the results of continuing cavitation studies. Experimental results for three, scaled, quarter-caliber ogives are given. Both desinent and developed cavity data, using liquid hydrogen and liquid nitrogen, are reported here. The desinent data do not exhibit a consistent ogive size effect, but the developed cavity data were consistently influenced by ogive size—B-factor increases with increasing ogive diameter. The developed cavity data indicated that stable thermodynamic equilibrium exists throughout the vaporous cavities. These data were correlated using the extended theory derived in Volume II of this report series. The new correlating parameter, MTWO, improves data correlation for the ogives, hydrofoil, and venturi and appears attractive for future predictive applications. The cavitation coefficient, $K_{c,min}$, and equipment size effects are shown to vary with specific equipment-fluid combinations. A method of estimating $K_{c,min}$ from knowledge of the noncavitating pressure coefficient is suggested.

**13736.** O'Connell, J. S., **Neutrino disintegration of the deuteron,** (Proc. Int. Conf. on Few Particle Problems in the Nuclear Interaction, Los Angeles, Calif., Aug. 28-Sept. 1, 1972). Paper

in *Few Particle Problems in the Nuclear Interaction*, I. Slaus, S. A. Moszkowski, R. P. Haddock, and W. T. H. van Oers, Eds., pp. 906-909 (North Holland Publishing Co., Amsterdam, The Netherlands, 1972).

Key words: Carbon; deuteron; interaction neutrino; neutron.

The cross section for the reaction $D(\nu_e,e^-)2p$ averaged over the neutrino spectrum expected from the beam stops of high-intensity proton accelerators is given. Calculations were carried out using a multipole expression for the neutrino-nucleus interaction and the effective-range theory for the electromagnetic breakup of the deuteron.

**13737.** Freeman, D. H., Kuehner, E. C., **Laser detection of small particles in liquids,** *Annals N.Y. Acad. Sci.* **158,** Article 3, 731-740 (June 20, 1969).

Key words: Air pollution; laser; light scattering; liquid pollution; particulate matter; water pollution.

A 0.3 milliwatt He-Ne laser is used with a photomultiplier to survey the light scattered by particulate matter suspended in small (7 ml) samples of liquids. Estimates of weight compositions are inferred by calibration against reference solutions of suspended polystyrene latex. A small size dependence is observed in the particle size range of 0.1 to 2.0 microns. The method is useful in the range of one part per million (PPM) to one part per billion (PPB). Results are reproducible with relative errors of approximately twenty percent.

Samples of solid chemical reagents dissolved in distilled water have been examined. The results show variable contamination levels up to 1 ppm. A sample of NBS pond water indicated 1 ppm. The effect of ultra filtration is easily demonstrated. As a side benefit, the scattered laser beam is easily inspected in liquids to show gross presence or absence of suspended matter.

**13738.** Danielson, S. L., Howe, D. A., **Use of the television vertical interval to broadcast time for everyone and program captions for the deaf,** *Commun. Soc.* **11,** No. 5, 3-6 (Nov. 1973).

Key words: Digital code; integrated circuit chip; program captioning; television; time and frequency dissemination; TvTime.

This paper describes the events leading to the development of the NBS TvTime System for both time and frequency dissemination and program captioning for the deaf. It explains how the system works, its advantages over other systems, and its cost. Finally, it discusses the possible implications of such a system for future communication applications. The text is written in laymen's language to suit the publication.

**13739.** Mopsik, F. I., Broadhurst, M. G., **Grüneisen constants of polymers,** *J. Appl. Phys.* **44,** No. 10, 4261-4264 (Oct. 1973).

Key words: Bulk modulus; Grüneisen constant; infrared; lattice vibrations; polyethylene; polymers.

One result of recent interest in Grüneisen constants, $\gamma = -d\ln\nu/d\ln V$, of polymers is a considerable spread of reported $\gamma$'s for solids like polyethylene. From elasticity data (bulk modulus or sound velocities for example) one finds $\gamma \approx 6$ for linear polymer solids. Values of $\gamma$ from thermal data are much lower than 6 because the relationship usually employed, $\gamma = \alpha BV/C_v$, is not valid for polyatomic solids. Measurements of the shifts in lattice frequencies with volume strains are the most direct way of measuring $\gamma$. However, the results for pressure-induced strains differ from those for temperature-induced strains, and both differ from the results from elasticity data. In this paper we consider vibrations in a simple anharmonic well and show how the apparent shifts in vibrational frequency with pressure and temperature can be derived from changes in force constants.

**13740.** Currie, L. A., **On the use of small calculators having stacked registers,** *Anal. Lett.* **6,** No. 9, 847-864 (1973).

Key words: Instruction list; iteration; memory register; operational stack; pop-up; Polish notation; push-down; radioactivity and isotopic calculations; recursion; statistical calculations.

The incorporation of an operational stack considerably enhances the potential of the small calculator. Full use of the stack permits calculations involving a stored constant or two or more intermediate results, but it requires careful planning and execution. Regardless of whether the calculator is "programmable," an explicit instruction list, preferably written down, may contribute greatly to the rapidity and accuracy of such calculations. The "pop-up" feature of the stack is of particular interest, for it can be utilized to increase the permanent storage capacity. A comparison between conventional (memory) storage and stack storage is given, and examples are presented for the application of a calculator having a 4-register stack (plus 1-memory register) to problems involving 2 parameters and/or summations, iterative solution of a transcendental equation, and recursion.

**13741.** Ederer, D. L., **Cross-section profiles of resonances in the photoionization continuum of krypton and xenon (600-400 Å),** *Phys. Rev. A* **4,** No. 6, 2263-2270 (Dec. 1971).

Key words: Autoionization; configuration interaction; inner shell excitation; photoionization cross section; resonance profiles; uv absorption spectroscopy.

The cross-section profiles in krypton and xenon have been measured for one- and two-electron excitations of the type $ns^2np^6(^1S_0) \rightarrow nsnp^6(^2S_{1/2})mp$ or $ns^2np^6(^1S_0) \rightarrow ns^2np^4(^3P, {}^1D, {}^1S)mlm'l'$. These cross sections were assumed to have the form

$$\sigma(E) = C(E) + \sum_i \frac{(E-E_i)(\Gamma_i/2)a_i + (\Gamma_i/2)^2 b_i}{(E-E_i)^2 + (\Gamma_i/2)^2},$$

where the adjustable parameters $C(E)$, $b_i$, $a_i$, $E_i$, and $\Gamma_i$ were determined by a least-squares unfolding process which separated the smearing effect of the monochromator slit from the true optical density. Parameter values and cross-section curves are given for 12 krypton resonances and 11 xenon resonances.

**13742.** Negas, T., Roth, R. S., Parker, H. S., Brower, W. S., **Crystal chemistry of lithium in octahedrally coordinated structures. I. Synthesis of $Ba_8(Me_6Li_2)O_{24}$(Me = Nb or Ta) and $Ba_{10}(W_6Li_4)O_{30}$. II. The tetragonal bronze phase in the system $BaO$-$Nb_2O_5$-$Li_2O$,** *J. Solid State Chem.* **8,** No. 1, 1-13 (1973).

Key words: $Ba_8Nb_6Li_2O_{24}$; $BaO$-$Nb_2O_5$-$Li_2O$ systems; $Ba_8Ta_6Li_2O_{24}$; $Ba_{10}W_6Li_4O_{30}$; close-packed oxides; crystal growth; tetragonal bronzes.

The preparation, single crystal growth, and crystallographic properties of a close-packed, eight-layer, hexagonal ($a = 5.803$ Å, $c = 19.076$ Å) modification having the stoichiometry $Ba_8Nb_6Li_2O_{24}$ and of a close-packed, ten-layer, hexagonal ($a = 5.760$ Å, $c = 23.742$ Å) phase with $Ba_{10}W_6Li_4O_{30}$ stoichiometry are discussed. The isostructural $Ba_8Ta_6Li_4O_{24}$ form of the eight-layer phase was also prepared ($a = 5.802$ Å, $c = 19.085$ Å). Proposed crystal structures involve the pairing of lithium and metal (Nb, Ta, or W) octahedra to yield face-sharing units. The relationship of this phenomenon to other known close-packed phases containing Li is demonstrated. An investigation of the $Ba_8Nb_6Li_2O_{24} - Ba_{10}W_6Li_4O_{30}$ system is reported.

A tetragonal bronze phase homogeneity region was delimited at 1200 °C in the $BaO - Nb_2O_5 - Li_2O$ system. A new orthor-

hombic phase ($a = 10.197$ Å, $b = 14.882$ Å $c = 7.942$ Å) was prepared with the stoichiometry $Ba_4Li_2Nb_{10}O_{30}$.

**13743.** Broadhurst, M. G., Mopsik, F. I., **Vibrational frequency spectrum for polymers,** *J. Chem. Phys.* **55,** No. 8, 3708-3711 (Oct. 15, 1971).

Key words: Frequency spectrum; linear chains; *n*-alkanes; polyethylene; polymer.

A method is given for calculating the vibrational frequency spectrum of a model linear polymer. The model is a chain of $N$ masses having bending and stretching force constants. Each mass is quasiharmonically coupled to a Debye lattice which has a cutoff frequency $\omega_L$. Each of the $3N$ free chain eigenfrequencies $\omega_j$ becomes a band with a low frequency cutoff $\omega_{jmin}^2 = \omega_j^2$, a high frequency cutoff $\omega_{jmax}^2 = \omega_j^2 + \omega_L^2$, and a pseudo-$n$-dimensional Debye distribution $g_j(\omega) = n\omega^{n-1}/(\omega_{jmax}{}^n - \omega_{jmin}{}^n)$ for $\omega_{jmin} < \omega < \omega_{jmax}$. The total frequency distribution agrees closely with the results by Genensky and Newell for the Stockmayer and Hecht lattice using their force constants and compares reasonably well with results of GF matrix calculations for polyethylene.

**13744.** Evans, A. G., **Strength degradation by projectile impacts,** *J. Amer. Ceram. Soc.* **56,** No. 8, 405-409 (Aug. 1973).

Key words: Ceramics; fracture; impact; projectiles.

The impacting of ceramic components by small projectiles can lead to strength degradation caused by the formation of Hertzian cracks. The conditions which produce degradation are analyzed in terms of the momentum and elastic properties of the projectile. A critical momentum must be exceeded before strength loss can occur, and the critical condition depends on the surface condition of the ceramic. Comparison of the analytical predictions with data for SiC confirms the reliability of the analysis.

**13745.** Brauer, G. M., Termini, D. J., **Grafting of acrylates and vinyl chains onto collagen with ceric initiator,** *J. Appl. Polym. Sci.* **17,** 2557-2568 (1973).

Key words: Acrylate copolymers; ceric ion initiated; grafting collagen; graft polymerization; modification of collagenous surfaces.

To determine the scope of the grafting reaction, over 30 monomers were grafted to steer hide collagen and collagen films using ceric ammonium nitrate as initiator. High yields of apparent graft polymer were obtained with most acrylate and methacrylate esters. Yields were not changed greatly by employing the higher homologues. Moreover, monomers containing such diverse substituents as hydroxy, cyano, chloro, trifluoroethyl, or glycidyl groups may be grafted onto collagen. The presence of these functional groups in the products provides potential reaction centers to further modify the collagenous surface. Presence of vinyl polymer was confirmed by IR spectra. The large number of monomers of varying polarity which were found to undergo apparent grafting makes it possible to vary widely the surface properties of collagen. It was shown that certain monomers impart water and oil repellency to collagenous surfaces, whereas others increased the hydrophilicity or oleophilicity of the substrate. Thus; by proper selection of monomers, the desired degree of hydrophilic to hydrophobic or oleophilic to oleophobic balance of the collagen surface to suit specific applications can be obtained.

**13746.** Chesler, S. N., Cram, S. P., **Iterative curve fitting of chromatographic peaks,** *Anal. Chem.* **45,** No. 8, 1354-1359 (July 1973).

Key words: Chromatography; curve fittings; moment analysis.

Iterative curve fitting of an eight parameter function to chromatographic peak profiles by nonlinear residual least squares is reported. Gaussian, exponential, and hyperbolic tangent functions are convoluted and iteratively fit to any experimental chromatographic peak shape and integrated to give total statistical moments with errors as small as 1 percent, even for the higher order moments. Exponential and band broadening operators are deconvolved for measurement of physicochemical and analytical studies. The models and calculations may be extended to the resolution of overlapping peaks and complex elution profiles for the measurement of the rate of on-column chemical reactions.

**13747.** Candela, G. A., Kahn, A. H., Negas, T., **Magnetic susceptibility of $Co^{4+}(d^5)$ in octahedral and tetrahedral environments,** *J. Solid State Chem.* **7,** No. 4, 360-369 (1973).

Key words: $Co^{4+}$ compounds; crystal fields; magnetic susceptibility; theory of magnetic susceptibility.

Measurements of magnetic susceptibility on compounds containing stoichiometric $Co^{4+}$ are reported. The compound $Ba_2CoO_4$ has the $Co^{4+}(d^5)$ ion at a tetrahedral site and displays a susceptibility of the expected magnitude for $S = 5/2$. The compounds $Ba_3Co_2CO_9$ and $BaCoO_3$ have the $Co^{4+}$ at an octahedral site and show a susceptibility expected for low spin, $S = 1/2$. For the low spin case significant deviations from Kotani's calculated susceptibility were observed. Improvement of the theory was made through incorporation of the effects of distortion from perfect octahedral symmetry and the inclusion of higher electronic configurations above $t_2{}^5$ in the $^2T_2$ ground state. A case of low spin Ni in octahedral environment is also reported.

**13748.** Okabe, H., Dibeler, V. H., **Photon impact studies of $C_2HCN$ and $CH_3CN$ in the vacuum ultraviolet; heats of formation of $C_2H$ and $CH_3CN$,** *J. Chem. Phys.* **59,** No. 5, 2430-2435 (Sept. 1, 1973).

Key words: Acetonitrile; cyanoacetylene; $C_2H$; heat of formation; photodissociation; photoionization; vacuum ultraviolet.

A photodissociation process to produce CN $B^2\Sigma$ from $C_2HCN$ and $CH_3CN$ has been studied as a function of incident wavelength. Threshold photon energies required for the production of CN $B^2\Sigma$ from $C_2HCN$ and $CH_3CN$ are $9.41 \pm 0.04$ and $8.52 \pm 0.03$ eV, respectively, from which $D_0(C_2H - CN) \leq 6.21 \pm 0.04$ eV and $D_0(CH_3 - CN) \leq 5.32 \pm 0.03$ eV are obtained. The photoionization yield curves have been measured for the $C_2HCN^+$ and $C_2H^+$ ions. Threshold photon energies obtained for the production of CN $B^2\Sigma$, $C_2HCN^+$, and $C_2H^+$ from $C_2HCN$ lead to the following thermochemical values; I.P.$(C_2HCN) = 11.64 \pm 0.01$ eV, I.P.$(C_2H) = 11.96 \pm 0.05$ eV, $\Delta Hf_0°$ $(C_2HCN) \geq 85 \pm 1$ kcal mol$^{-1}$ ($355 \pm 4$ kJ mol$^{-1}$). $\Delta Hf_0°$ $(C_2H) = 127 \pm 1$ kcal mol$^{-1}$ ($531 \pm 4$ kJ mol$^{-1}$) and $D_0(C_2H - H) = 5.38 \pm 0.05$ eV. $\Delta Hf_0°$ $(C_2H)$ obtained is in good agreement with the recent value obtained directly from a study of the high temperature reactions of graphite with hydrocarbons. $\Delta Hf_0°$ $(CH_2CN) \geq 14 \pm 1$ kcal mol$^{-1}$ ($59 \pm 4$ kJ mol$^{-1}$) derived from $D_0$ $(CH_3 - CN)$ agrees within the stated error limit with the value obtained recently by bomb calorimetry. The fluorescence efficiency vs incident wavelength curves for $C_2HCN$ and $CH_3CN$ show several peaks corresponding to Rydberg states indicating that the process is predissociative. The absorption coefficient of $C_2HCN$ has been measured in the vacuum ultraviolet. The photoionization yield curve for $C_2HCN^+$ shows at least two Rydberg series converging to vibrationally excited $C_2HCN^+$ ions.

**13749.** Mulholland, G. W., **Line of symmetry for the classical equation of state,** *J. Chem. Phys.* **59,** No. 5, pp. 2738-2741 (Sept. 1, 1973).

Key words: Classical equation of state; coexistence curve; critical phenomena; diameter of coexistence curve; line of symmetry; liquid-vapor phase transition.

The existence and properties of the Widom-Stillinger line of symmetry are examined for the "classical" equation of state, that is, an equation of state in which the chemical potential is expressed as a power series in density and temperature. In doing this, the chemical potential is shown to be an analytic function of temperature in the two phase region. This analyticity has been anticipated for a number of years.

**13750.** Morris, J. C., Walker, J. H., **Electron-neutral transport cross section of mercury,** *J. Appl. Phys.* **44,** No. 10, 4558-4561 (Oct. 1973).

Key words: Arc mercury; conductivity; cross section; electrical conductivity of mercury; electron-neutral; electron-neutral transport cross section of mercury; mercury arc.

The electron-neutral transport cross section and the electrical conductivity of Hg have been determined using a constricted dc Hg arc. This arc has a novel configuration which permits the precise measurement of the pressure, the voltage gradient, the temperature profile, and the total current. For the temperature range 5000-6500 K, the electron-neutral transport cross section was found to be $1 \times 10^{-14}$ cm$^2$ with a precision of $\pm 6$ percent and an absolute accuracy of $\pm 20$ percent. A description of the apparatus and technique is presented as well as a comparison with other existing data.

**13751.** Bowen, B. E., Cram, S. P., Leitner, J. E., Wade, R. L., **High precision sampling for chromatographic separations,** *Anal. Chem.* **45,** No. 13, 2185-2191 (Nov. 1973).

Key words: Computer-based data acquisition; gas chromatography.

The precision of several chromatographic sampling valves of original design is shown to approach 0.05 percent for unretained solutes. Hybrid-fluidic, high pressure, and commercial valves have been characterized by measuring the precision of their column input profiles and statistical moments. A computer-based data acquisition and control system was developed for use with high precision algorithms.

**13752.** Phelan, R. J., Jr., Cook, A. R., **Electrically calibrated pyroelectric optical-radiation detector,** *Appl. Opt.* **12,** No. 10, 2494-2500 (Oct. 1973).

Key words: Calibration; detector; infrared; pyroelectric; radiometers; ultraviolet.

An electrically calibrated optical detector has been developed using a pyroelectric response of the plastic, polyvinylfluoride. An in-depth look at the modulation frequency response was performed to substantiate the equivalence of the optical and electrical inputs, indicate the optimum structure and allow for a clearer understanding of the device limitations. The experimental results of the dynamic range, linearity, uniformity, and detectivity confirm the device's utility.

**13753.** Kidnay, A. J., Hiza, M. J., Miller, R. C., **Liquid-vapour equilibria research on systems of interest in cryogenics—A survey,** *Cryogenics* **13,** No. 10, 575-599 (Oct. 1973).

Key words: Annotated bibliography; binary systems; cryogenic fluid mixtures; liquid-vapour equilibria; multicomponent systems; survey.

This survey provides a convenient summary of available data on liquid-vapour equilibria for systems of interest in cryogenics. An annotated bibliography of 392 references has been compiled, current to January 1973. These references have been scanned individually with few exceptions, and cross-indexed by system with notation of extent of data and other significant features. The systems included are those made up of the possible combinations of $H_2(D_2, HD)$, $N_2$, $O_2$, $F_2$, CO, $H_2S$, $He(He^3)$, Ne, Ar, Kr, Xe, and the saturated and unsaturated hydrocarbon through the $C_4$s.

**13754.** O'Connell, J. S., **Electromagnetic sum rules,** (Proc. Int. Conf. on Photonuclear Reactions and Applications, Pacific Grove, Calif., Mar. 26-30, 1973), Paper in *International Conference on Photonuclear Reactions and Applications,* B. L. Berman, Ed., pp. 71-94 (Ernest O. Lawrence Livermore Laboratory, University of California, Livermore, Calif., 1973). (Available as CONF-730301 from the National Technical Information Service, Springfield, Va. 22151).

Key words: Effective interaction; electron scattering; nucleon-nucleon correlations; photoabsorption; photon scattering; sum rules.

A survey of total and partial nuclear cross section sum rules for photoabsorption and electron scattering is presented. The sums are derived from closure or the dispersion relation and are compared with available data and discussed in the context of the single particle shell model. A few of the rules are model-independent or relate observables, but most are influenced either by the form of the effective two-nucleon interaction or by nucleon-nucleon correlations in the nuclear ground state. The relation of electron scattering sums in the low momentum transfer region to photo sums is emphasized. A new sum rule for elastic photon scattering is given.

**13755.** Pella, P. A., DeVoe, J. R., **Internal standardization in Mössbauer spectrometry,** *Appl. Spectrosc.* **25,** No. 4, 472-474 (July/Aug. 1971).

Key words: Beta-tin; internal standardization; Mössbauer spectroscopy.

The concept of internal standardization is applied in quantitative analytical studies using the Mössbauer spectrometric technique. The ratio of the absorption intensity of $SnO_2$ (analyte absorber) to that of $\beta-Sn$ (internal standard absorber) is measured using $BaSn^{119m}O_3$ as the source. The results demonstrate that the systematic error which arises because of differences in the chemical composition between the analyte samples and standards can be eliminated by using an internal standard.

**13756.** Broadhurst, M. G., **Fluctuation-barrier model for rotational relaxation,** (Proc. Conf. Electrical Insulation and Dielectric Phenomena, Buck Hill Falls, Pa., Oct. 20-22, 1969), Chapter in *1969 Annual Report of the Conference Electrical Insulation and Dielectric Phenomena,* pp. 48-54 (National Research Council, National Academy of Sciences, Washington, D.C., 1970).

Key words: Elastic barrier; lattice; molecular rotation; relaxation; temperature dependence.

A model is presented where the barrier to molecular rotation in solids is taken to be the work to elastically expand the lattice around the molecule. This barrier is shown to increase with pressure and decrease with temperature. The model calculations are compared to data on long chain paraffin-like solids for the dielectrically active relaxation involving rotation of the entire molecule around its chain axis (analogous to the $\alpha$ relaxation in polymers). The model accurately predicts the temperature dependence of the relaxation time (the activation entropy in the Eyring Theory), and the Eyring activation energy (the activation energy does not equal the elastic barrier height). The predicted pressure dependence of the relaxation time is in error by a factor of 2 indicating the need for further refinement of the model. This paper reports the current status of this problem.



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**13757.** Ederer, D. L., Lucatorto, T., Madden, R. P., **Resonances in the photoionization continuum of lithium I (55 to 70 eV),** *J. Phys.* **32,** Supplement to No. 10, C4-85–C4-87 (Oct. 1971).

Key words: Absorption; heat pipe; K-edge; lithium; resonances; spectrum.

Resonances in the photoionization continuum of lithium have been observed by absorption spectroscopy in the region of 55 to 70 eV. These resonances are associated with configurations of the type (1 s 2 snl) and (1 snln'l') and lie more than 50 eV above the ionization potential; the lowest lying most prominent of these can be identified with configurations of the type (1 s 2 snp) $^2$P. A multiconfiguration calculation for the first five members of the series (performed by A. Weiss) has yielded values for the energies which agree with experimental results to within 2 eV.

The design of the lithium vapor absorption furnace was based on the heat-pipe principle. Argon, which has very little structure in the region from 55 to 70 eV, was used as a buffer gas and was contained inside the furnace by thin film aluminum windows. The light source was the 180 McV NBS synchrotron.

**13758.** Carpenter, B. S., Samuel, D., Wasserman, I., **Quantitative applications of $^{17}$O tracer,** *Radiat. Eff. Short Commun.* **19,** 59 (1973).

Key words: Alpha tracks; alumina; cellulose acetate; citric acid; image analyzing system; nuclear track technique; oxygen tracer; thermal neutrons.

We describe the use of alpha tracks from the $^{17}O(n, \alpha)^{14}C$ as a means of oxygen determination and distribution in biological material. A determination of oxygen in alumina and citric acid using enriched tracer was made.

**13759.** Verdier, P. H., **Fluctuations in autocorrelation functions in diffusing systems,** Chapter in *Stochastic Processes in Chemical Physics,* K. E. Shuler, Ed., **15,** 137-148 (John Wiley & Sons, Inc., New York, N.Y. 1969).

Key words: Autocorrelation; correlation; diffusion; fluctuations; relaxation; time correlation.

The relative rates of relaxation of the autocorrelation function and the fluctuations in its sampled values are derived for several simple diffusing systems. It is found that in general, the autocorrelation function and its fluctuations relax at rates which are different, but of the same order of magnitude. In the cases studied, the ratio of the relaxation time for the fluctuations to that for the autocorrelation function varies from about 1/2 to about 1 1/6.

**13760.** Stillman, R. B., **The concept of weak substitution in theorem-proving,** *J. Ass. Comput. Mach.* **20,** No. 4, 648-667 (Oct. 1973).

Key words: Associative processing; first-order predicate calculus; resolution; subsumption; theorem-proving; unification.

Many of the centrally important predicates which occur within theorem-proving programs involve, in their computation, a subcalculation aimed at determining whether or not a substitution exists satisfying certain constraints. Some of the principal difficulties in achieving efficient theorem-proving programs are traceable to the amount of computation required by this "substitution-existence analysis." In this investigation, the concept of "weak substitution" is introduced and its utility and applicability in the subsumption and unification computations are examined. The main motivation for considering weak substitutions is this: the existence of a *weak* substitution having certain properties is relatively easy to detect, whereas the existence of a substitution proper having the same properties is not. Furthermore, the absence of such a weak substitution is a sufficient condition for the absence of the substitution proper. Using the concept of weak substitution, a particularly efficient implementation of the subsumption and unification computations on an associative processor is presented.

**13761.** Lyndon, R., McDonough, T., Newman, M., **On products of powers in groups,** *Proc. Amer. Math. Soc.* **40,** No. 2, 419-420 (Oct. 1973).

Key words: Free groups; powers.

In this note we show that a product of $N$th powers in a group cannot in general be expressed as a product of fewer $N$th powers. This extends a result of Lyndon and Newman.

**13762.** Ordman, E. T., **Convergence and abstract spaces in functional analysis,** *J. Undergraduate Math.* **1,** No. 2, 79-96 (Sept. 1969); **2,** No. 1, 25-36 (Mar. 1970).

Key words: Convergence; filter; function space; limit space; linear topological space; net; topological space.

This paper is an expository survey of the theory of limit spaces, discussing and contrasting approaches by way of nets and filters and considering a number of the extant ways of axiomatizing such a structure. Applications are given to a number of common notions of convergence of functions and to the topology of function spaces linear topological spaces.

**13763.** Meinke, W. W., **Is radiochemistry the ultimate in trace analysis?,** *Pure Appl. Chem.* **34,** 93-104 (1973).

Key words: Accuracy error limits; activation analysis; atomic absorption; instrument biases; isotope-dilution; method biases; nuclear track technique; practical samples; radiochemistry; trace analysis techniques.

Proponents of widely-used analysis methods such as atomic absorption, spark source mass spectrometry, polarography, activation analysis, etc. often give the impression that their methods alone can solve a large fraction of the problems of trace analysis. In addition, from time to time new, specialized trace methods are reported and sometimes find use in solving special analytical problems. However, the trace analyst deceives himself and, worse yet, gives false impressions to others unless he is able to understand the biases of his methods and instruments in relation to other possible methods and instruments,—and in addition express these biases quantitatively as accuracy error limits. Our experience at NBS in certifying trace element Standard Reference Materials in matrices as diverse as glass, orchard leaves, gold, zinc, beef liver, tuna fish and coal has given us an insight into the optimum contributions which can be made of these methods. The advantages and disadvantages of activation analysis as well as of several other types of radiochemical methods will be discussed in relation to other trace analysis techniques, based on our NBS experience in practical trace analysis. It is concluded that activation analysis ranks high among the methods for trace analysis of real samples.

**13764.** Ballard, L. D., Edelman, S., Epstein, W. S., Smith, E. R., **A suggestion for determining g by a two interferometer technique,** *SPIE J.* **9,** No. 5, 166-168 (June/July 1971).

Key words: Acceleration; counter; filter; g; gravity; interferometer; laser.

A method for determining the acceleration due to gravity is suggested. Two falling interferometer reflectors illuminated by a laser are used. The falling reflectors are separated by a $\Delta T$ and thus have a constant velocity differential, this generates a frequency linearly proportional to acceleration ($g = kf = \Delta V/\Delta T$).

Thus, the metrology of measuring g is simplified by having g linearly proportional to frequency.

**13765.** Greenspan, M., **Transducer measurements: Use of the current probe,** *J. Acoust. Soc. Amer. Tech. Notes and Res. Briefs* **53,** No. 4, 1186-1187 (Apr. 1973).

Key words: Current probe; impedance measurements; piezoelectric transducer measurements; transducer measurements; ultrasonic instruments.

It has been found that various measurements commonly made on piezoelectric transducers are simplified by use of the current probe, a commercially available instrument. Examples are impedance, ultrasonic interferometry, and power.

**13766.** Spurgeon, J. C., **Response characteristics of a portable x-ray fluorescence lead detector: Detection of lead in paint,** *NBSIR 73-231,* 37 pages (June 1973). (Available as PB 224645 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Lead paint detection; portable x-ray fluorescence lead detector; portable x-ray fluorescence lead calibration standards.

The objective of this investigation was to obtain an indication of the validity of the field data resulting from the use of portable x-ray fluorescence lead detectors by local lead paint detection programs. This report is intended to provide guidance in the use of portable x-ray fluroescence lead detectors by housing and/or health authorities who are responsible for the collection and interpretation of field data as part of lead paint control programs.

The response characteristics of such an instrument to conditions that are related to those encountered in the field have been investigated and the results are presented in this report. The effects of calibration standards, state of charge, paint overlayers, substrate, and distance on instrument response are discussed, in addition to the limit of detection and precision. The accomplishment of these tasks required the development of panel-type lead calibration standards. These standards encompass the concentration range from 0.1 $mg/cm^2$ to 9.0 $mg/cm^2$.

**13767.** Boone, T. H., Ray, T. R., Street, W. G., **Pilot demonstration of lead based paint hazard elimination methods,** *NBSIR 73-242,* 38 pages (June 1973). (Available as PB 224654 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Cost analysis; hazard elimination; housing; lead based paint; materials; surface preparation; surface refinishing.

This report describes the elimination of the hazard of lead bearing paints in a one bedroom apartment using materials and procedures that are undergoing laboratory and field evaluation by the National Bureau of Standards (NBS). Paint removal was used to eliminate the hazard from some surfaces and two non-hazardous membrane type coverings were installed as barrier materials over the residual leaded paint on other surfaces. The preparation and refinishing of the interior surfaces are described and work rates and cost data are presented.

This pilot demonstration is the first of a series of studies that will be used to determine the merits of various lead based paint hazard elimination methods when applied to actual housing conditions.

Final recommendations for further use of materials and systems, described in this report, are not presented due to the preliminary nature of this work. The completion of the projected series of demonstrations and the long term evaluation of the in-use performance of the materials and systems will be required before final recommendations can be made.

**13768.** Paabo, M., **Analytical methods for the detection of toxic elements in dry paint matrices—a literature survey,** *NBSIR 73-251,* 49 pages (July 1973). (Available as PB 224688 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Analytical methods; antimony; arsenic; cadmium; lead; mercury; review; selenium; toxic elements in paints.

This report is a summary description of the chemical procedures currently available for the analysis of selected toxic elements in dried paint. The elements included in this report are lead, mercury, cadmium, antimony, arsenic, and selenium. The literature search upon which this report is based was directed primarily toward references pertaining to the analysis of dried paint. A bibliography of 57 references to wet chemical analysis, colorimetry, atomic absorption spectroscopy, electrochemistry, neutron activation analysis, and x-ray emission analysis is presented.

**13769.** Kruger, J., Ambrose, J. R., **The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility,** *NBSIR 73-244,* 75 pages (July 1973). (Available as AD 767326 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Chloride; crevice corrosion; dissolved oxygen; ellipsometry; nitrates; pH; repassivation kinetics; stainless steel; stress corrosion cracking; titanium alloys.

Repassivation kinetics of an AISI 304 stainless steel have been determined in 1.0N NaCl solutions using the triboellipsometry technique which permits measurement of film growth and total reaction rates following removal of the surface film by abrasion. Although deoxygenation of the solution resulted in little change in either film growth kinetics or the ratio of total change to film thickness ($R_\mu$), changing the solution pH affected both the mechanism and rate of film growth which resulted in increased rates of metal dissolution in acidic (pH3) and basic (pH11) solutions.

The triboellipsometry technique was also used to determine repassivation kinetics and stress corrosion cracking (SCC) susceptibility for Ti-8Al-1Mo-1V alloy. Repassivation transient behavior in a 1.0N NaCl solution, where cracks have been found to propagate, was compared to that in a 1.0N $NaNO_3$ solution where SCC susceptibility has never been detected. Susceptibility was found to be related to film growth kinetics in the two solutions.

The early stages of crevice corrosion of AISI 304 stainless steel in 1.0N NaCl solution have been detected using the ellipsometer to measure changes in optical properties occurring within the crevice between a polished metal surface and a glass plate. Changes in the ellipsometer parameters $\Delta$ and $\psi$ begin almost immediately upon creation of the crevice and can be interpreted as resulting from a build-up of soluble species within the crevice solution, followed by an overall thinning of the protective film and general corrosion attack.

**13770.** Hampson, R. F., Garvin, D., Herron, J. T., Huie, R. E., Kurylo, M. J., Laufer, A. H., Okabe, H., Scheer, M. D., Tsang, W., **Chemical kinetics data survey VI: Photochemical and rate data for twelve gas phase reactions of interest for atmospheric chemistry,** *NBSIR 73-207,* 127 pages (Aug. 1973). (Available as AD 769266 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Atmospheric chemistry; chemical kinetics; data evaluation; gas phase reaction; optical absorption cross section; photochemistry; quantum yield; rate constants.

Photochemical and rate data have been evaluated for twelve gas phase reactions of interest for the chemistry of the stratosphere. The results are presented in data sheets, one for each reaction. For each reaction the data are summarized. A preferred value is given for the rate constant or the primary quantum yield and photoabsorption cross section.

**13771.** Sanchez, I. C., Colson, J. P., Eby, R. K., **Theory and observations of polymer crystal thickening,** *J. Appl. Phys.* **44,** No. 10, 4332-4339 (Oct. 1973).

Key words: Annealing; comonomer inclusion; copolymers; lamella thickness; theoretical and experimental; thickening; unit cell.

The thickening of polymer crystals during isothermal annealing is usually observed to be an irreversible process. Phenomenological laws that govern such processes take the form of simple proportionalities – flux being proportional to force. For polymer crystals, á thermodynamic force capable of driving the thickening phenomenon arises from the unequal free energies of the fold and lateral surfaces. By analogy with other irreversible phenomena, the rate of crystal thickening is taken to be proportional to the derivative of the surface free energy with respect to crystal thickness. After certain assumptions, integration yields an equation in which three parameters characterize the system: an initial thickness $l_0$, and equilibrium thickness $l^*$, and a relaxation time $\tau$ which is a function of the "undercooling." The theory provides a basis for considering the effects of parameters such as time, temperature, thermal history, pressure, and liquids on the thickening rate. In particular, the theory adequately describes the time and temperature dependence of crystal thickening in random copolymers of tetrafluorethylene and hexafluoropropylene which exhibit thickening behavior completely analogous to that of homopolymers. During thickening, the unit cell dimensions of *these quenched-crystallized copolymers* decrease in a manner that is consistent with the concept of complete comonomer inclusion upon crystallization.

**13772.** Ogburn, F., Johnson, C. E., **Banded structure of electroless nickel,** *Plating Technical Brief,* pp. 1043-1044 (Oct. 1973).

Key words: Electroless nickel; electroless plating; nickel phosphorus.

The cross section of an electroless nickel deposit was scanned for phosphorus with an electron probe. The variations in phosphorus content corresponded inversely with the degree of etching with the usual nitric-acetic acid etchant, which develops the striations characteristic of electroless nickel deposits.

**13773.** Livingston, R. C., Rothschild, W. G., Rush, J. J., **Molecular reorientation in plastic crystals: Infrared and Raman band shape analysis of neopentane,** *J. Chem. Phys.* **59,** No. 5, 2498-2508 (Sept. 1, 1973).

Key words: Band shape analysis; diffusion models; infrared; jump diffusion; molecular reorientation; neopentane; phase transition; plastic crystal; Raman; and rotational diffusion.

An infrared and Raman band shape analysis of the broadened 924 $cm^{-1}$ fundamental for neopentane in its liquid and plastic crystal phases is presented. Correlation functions and times for molecular reorientation derived from both the infrared and Raman data show the liquidlike behavior of the plastic phase of neopentane, with the molecules rotating "freely" through $\sim 10°$ (175 K) to $\sim 30°$ (300 K) around an inertial axis with the corresponding reduced intermolecular torques ($< L^2 >^{1/2} kT$) decreasing from 8.2 to 3.8. Furthermore, the linewidth and correlation time results show no indication of a change in rotational behavior in passing through the plastic crystal-liquid phase transition. Theoretical fits of our experimental infrared and Raman correlation function with Gordon's $M$ and $J$ diffusion models, as extended by McClung for spherical molecules, show that the experimental results lie between the functions predicted by these two models. The time between rotational "collisions" (angular momentum correlation time) varies continuously from $0.4 \times 10^{-12}$ sec for the room-temperature liquid to $0.2 \times 10^{-12}$ sec at the lowest temperature in the plastic phase. Activation energies for molecular reorientation of 4.1 and 3.6 kJ/mol are obtained, respectively, from the experimental half-widths and from the angular momentum correlation times, in good agreement with previous NMR and neutron scattering results. The results prove that neopentane melts in two stages: near 140 K, the rotational degrees of freedom of the (rigid) molecule are liberated, whereas near 253 K the translational degrees of freedom are liberated without observable change of the characteristics of the rotational motion.

**13774.** Davis, G. T., Eby, R. K., **Glass transition of polyethylene: Volume relaxation,** *J. Appl. Phys.* **44,** No. 10, 4274-4281 (Oct. 1973).

Key words: Dilatometer; isothermal volume change; polyethylene; specific volume; superposition; thermal expansion; volume relaxation, WLF.

Data are presented to show that when linear polyethylene is quenched from room temperature to temperatures below 273 K, it exhibits a volume decrease for times long compared with that required to establish temperature equilibrium. The time, temperature, and density dependence of this decrease is shown to be consistent with a relaxation occurring in the amorphous portion (lamella boundary layers) of the samples. The data can be superposed and the shift factors follow the WLF formalism. Analysis by this method yields a $T_g$ of $231 \pm 9$ K but the uncertainties preclude any correlation with specific volume over the range $1.01 - 1.05$ $cm^3$ $g^{-1}$. The data indicate the absence of any comparably strong time dependence of the volume near 150 K. This method of detecting a glass transition in partially crystalline polymers is relatively freer of subjective judgment than most.

**13775.** Ballantyne, J. P., Yakowitz, H., Nixon, W. C., **Simultaneous x-ray microanalysis and resistance measurement of electron beam induced direct metallic deposition,** (Proc. 6th Int. Conf. on X-Ray Optics and Microanalysis, Osaka, Japan, Sept. 1971), Paper in *Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis,* G. Shinoda, K. Kohra and T. Ichinokawa, Eds., pp. 219-227 (University of Tokyo Press, Tokyo, Japan, 1972).

Key words: Deposited thin film; electron beam metal deposition; scanning electron microscopy; x-ray microanalysis.

The decomposition of thin film AgCl, vapor deposited onto an oxidized silicon substrate, was caused by electron bombardment in a scanning electron microscope operating at a pressure of $10^{-8}$ torr. This decomposition was monitored by nondispersive x-ray analysis techniques. At the same time, the resistance of the film was also recorded.

The curves of chlorine concentration and resistance as a function of exposure are very similar in shape. The chlorine content of the film reaches a level that does not alter with increasing exposure. At this point, film resistance is about 1000 Ω and remains essentially constant with increasing exposure. The residual chlorine can be removed by chemical treatment after which the resistance values drop to less than 50 Ω.

The quantitation of the x-ray results must await new correction procedures presently under study. However, a simple

correction procedure has been employed in order to illustrate important trends in the direct metallic deposition process.

**13776.** Page, C. H., **Logarithmic quantities and units,** *Proc. IEEE Letters* **61**, No. 10, 1516-1517 (Oct. 1973).

Key words: Decibel; logarithm.

Recent letters on *decibel* are commented upon, and standardization proposed by the International Electrotechnical Commission (IEC) is mentioned.

**13777.** Stabler, T. M., **National program of metrology for Ecuador,** *NBSIR 73-157*, 33 pages (Apr. 1973). (Available as COM74-10394 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Calibration and testing; Ecuadorian Institute of Standardization (INEN); field inspections; mass, length, and volume standards; metrology laboratory; model law and regulations; technical education; U.S. AID.

At the request of the Ecuadorian Institute of Standardization (INEN) the U.S. AID made arrangements for a weights and measures advisor to assist in the development of a program for scientific and legal metrology, including the design of a metrology laboratory, inspection system, a training program, and other essential features. A four week survey by an NBS representative has resulted in recommendations for a metrology laboratory, physical standards, an Ecuadorian weights and measures law, regulations, and control program.

Considered also were the Ecuadorian National Standards of mass, length, and volume; precision balances, and other laboratory instruments. A program of technical education was recommended for an INEN engineer (Program Administrator) and for other members of the INEN laboratory staff.

**13778.** Wyly, R. S., Rorrer, D. E., **Field test of hydraulic performance of a single-stack drainage system at the operation BREAKTHROUGH prototype site in King County, Washington,** *NBSIR 73-161*, 66 pages (May 1973). (Available as PB225-310 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Crossflow; field testing, plumbing; performance criteria, plumbing; performance, functional; single-stack drainage; siphonage, induced; siphonage, self; test loads, hydraulic; trap-seal reduction detector; trap-seal retention.

A procedure for measuring the hydraulic performance of drain-waste-vent (DWV) systems in the field is described, and the results obtained with this procedure in a field demonstration of the hydraulic performance of a single-stack DWV system are presented.

Among the most important criteria for hydraulic performance of drain-waste-vent systems are the following: (1) Trap-seal retention in idle fixtures; (2) Ability of the system to resist the rejection of suds, sewage, or foul gases due to hydrostatic or pneumatic pressures in the DWV system; (3) Absence of cross flow between fixtures; (4) Absence of self-siphonage in the individual fixture traps.

Considering the needs for minimization of maintenance in service and for the continuation of venting during cold weather, the following additional criteria can be identified: (5) Ability to maintain adequate hydraulic performance over a long period of service without excessive maintenance of branch piping; (6) Adequacy of performance under climatic conditions conducive to frost closure of vent terminals.

The procedures for selection and application of hydraulic loads, based on state-of-the-art guidelines, are described as applied to the soil and waste stacks evaluated for conformance to criteria (1) through (4) above.

The results show adequate performance in relation to criteria (1) through (4), with a single example of non-conformance on criterion (3), subject to the limiting condition that some uncertainty exists as to the degree of leak resistance of the DWV systems made available for the tests.

Recommendations are offered concerning further work that could provide information to confirm estimated conformance to criteria (5) and (6).

**13779.** Finkel, P. W., Miller, T. R., **A proficiency test assessment of clinical laboratory capability in the United States,** *NBSIR 73-163*, 147 pages (May 1973). Supersedes COM73-11190, COM73,11193, and COM74-10552. (Available as COM-74-10542 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Accuracy; clinical chemistry; hematology; medical usefulness; microbiology; proficiency testing.

The proficiency of a representative sample of physician, hospital and independent laboratories was assessed with respect to their ability to analyse clinical chemistry and hematology samples and to identify microbiological organisms. For the assessment of clinical chemistry and hematology proficiency, the laboratories were grouped, and determinations of group accuracy and group precision were made. Further analyses were performed to determine relative accuracy and precision of the techniques presently applied by these groups. There was no significant difference at the 95 percent confidence level in the accuracy achieved by the various laboratory groups involved in clinical chemistry and hematology analysis. In clinical chemistry, the Medicare-Certified Independent Laboratories, CDC Tested Laboratories and JCAH-Members generally proved more precise than Physician's Office and Medicare-Certified Hospital Laboratories. However, none of the laboratory groups were sufficiently accurate to permit the monitoring over time of variation in an individual patient's constituent concentrations. It would appear that poor selection of techniques was an important contributor to this low performance level. In hematology the Physician's Office Laboratories proved to be the least precise of the groups. There was no noticeable difference in precision between participants in the CDC proficiency testing program and nonparticipants. With respect to microbiology, 76 percent of the identifications by laboratories participating in the CDC testing program were incorrect, while 19.4 percent of all other identifications were incorrect.

**13780.** Unassigned.

**13781.** Fribush, S. L., Bowser, D., Chapman, R., **Estimates of vehicular collisions with multistory residential buildings,** *NBSIR 73-175*, 72 pages (Apr. 1973). (Available as COM74-10395 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Collisions of vehicles with buildings; multistory buildings; progressive collapse of buildings; residential buildings; vehicular impact.

Through analysis of data from Oklahoma and Illinois along with national statistics, estimates are made of the number of vehicular collisions with buildings on an annual, nationwide basis. The best estimate is on the order of tens of thousands. However, since the impetus for the study was on multistory buildings and the likelihood of their being subject to progressive collapse the calculations have been refined to apply to substantial damage

to multistory residential buildings. In 1970, such accidents were only on the order of 40, hence the probability of a given building being so affected in a single year is approximately one in 10,000. Some discussion is provided on improvement for data collection for the future.

13782. Burnett, E. F. P., Somes, N. F., Leyendecker, E. V., **Residential buildings and gas-related explosions,** *NBSIR 73-208,* 31 pages (June 1973). (Available as COM74-10127 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Building; explosion; frequency; gas; gas industry; progressive collapse; risk; statistics; structure.

The findings of an analysis of available statistics concerning the frequency of gas-related explosions in residential buildings are presented. The study was confined to incidents involving piped gas systems as they affect residential and commercial buildings. Though due regard has to be taken of the limitations inherent in the available statistics, it is concluded that in the USA the probability of occurrence of an explosion capable of causing significant structural damage could be 2.2 per million housing units per year.

13783. Greifer, B., Taylor, J. K., **Survey of various approaches to the chemical analysis of environmentally important materials,** *NBSIR 73-209,* 237 pages (July 1973). (Available as COM74-10469 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Air pollution; atomic absorption; electron microprobe; emission spectroscopy; environmental analysis; industrial effluents; ion-selective electrodes; nuclear activation analysis; particulate analysis; polarography; spark source mass spectrometry; spectrophotometry; trace elements; water pollution; x-ray fluorescence.

Various approaches to the chemical analysis of heavy industry process materials and effluents for trace element constituents that might contribute to environmental pollution are summarized.

The capabilities and costs of nuclear methods, spark source mass spectrometry, x-ray fluorescence and electron microprobe spectrometry, atomic absorption spectrometry, absorption spectrophotometry, atomic emission spectroscopy, voltammetry (polarography) and potentiometry (ion-selective electrodes) for determining traces (less than 100 parts per million) of mercury, beryllium, cadmium, arsenic, vanadium, manganese, nickel, antimony, chromium, zinc, copper, lead, selenium, boron, fluorine, lithium, silver, tin, iron, strontium, sodium, potassium, calcium, silicon, magnesium, uranium, and thorium in such matrices as fly ash, coal, oil, ores, minerals, metals, alloys, organometallics, incinerator particulates, slurry streams, and feeds to and from sedimentation processes have been assessed.

The report includes a critically selected bibliography of the current literature.

13784. Abrams, M. D., Hudson, J. A., Meissner, P., Pyke, T. N., Jr., Rosenthal, R. M., Ulmer, F. H., **Use of computer networks in support of interactive graphics for computer-aided design and engineering,** *NBSIR 73-217,* 47 pages (June 30, 1972). (Available as COM74-10470 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Computer-aided design; computer networks; interactive graphics, performance measurement; remote computer utilization.

This report covers work performed between 1 July 1971 and 30 June 1972 as part of a long-term study of interactive computer-aided techniques. The primary emphasis during this period has been on investigating the feasibility of using computer networks in support of interactive graphics for computer-aided design and engineering. Alternative means for providing remote computer service have been studied. An experimental configuration has been devised taking advantage of the fact that there is located at the National Bureau of Standards a node of the ARPA Computer Network. Arrangements were made via this configuration for users at the Electronics Command to utilize a structural design program, NASTRAN, at a remote computer site. Emphasis has been placed on the evaluation of performance of interactive design techniques using displays supported by local and remote computers in a hierarchical arrangement. A variety of problems are identified which must be considered in order to support interactive graphics via a computer network; these are compounded where the network itself is in an evolving state of development. The report includes an outline of a synchronous communication protocol which was developed for use between ECOM and NBS.

13785. Llewellyn, L. G., Peiser, C., **NEPA and the environmental movement: a brief history,** *NBSIR 73-218,* 40 pages (July 1973).(Available from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Environment; environmental impact statement; environmental movement; National Environmental Policy Act (NEPA); politics and the environment.

This paper traces some of the critical events leading up to the National Environmental Policy Act (NEPA) of 1969. The opening section spotlights the rapid growth of an environmental ethic in this country, the impact of some highly visible ecological disasters, and the subsequent pressure for environmental reform exerted by opinion leaders and the mass media. The Federal Government's response to perceived changes in public priorities is the focal point of the second section. The activities of Congress and the Nixon Administration are charted in a two-year chronology spanning the 1968 and the 1970 elections, a key period in the development of environmental policy. The final section provides a critique of NEPA with special attention devoted to the controversial requirement for environmental impact statements. The paper concludes with a brief discussion of some of the challenges facing the environmental movement today.

13786. Ogburn, F., Johnson, C. E., **Effects of electroless nickel process variables on quality requirements,** *NBSIR 73-240,* 34 pages (June 1973). (Available from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Chemical nickel; coatings; electroless nickel; metal coatings; nickel; nickel-phosphorus.

Deposition rate, phosphorus content, hardness, appearance, and metal distribution are reported for deposits from two acid, hypophosphite type electroless nickel baths, one proprietary and one non-proprietary. The baths were operated under a variety of conditions with variations of composition. Extensive data is given on the relation of deposit hardness to phosphorus content and to heat treatment at 100, 200, and 400 °C.

13787. Fried, C., Ramsburg, R., Butler, S., **A survey of the sanitary conditions of migrant labor camps,** *NBSIR 73-248,* 81 pages (Aug. 1973). (Available as COM74-10474 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Health standards; migrant labor camps; questionnaire construction; regulations; survey design.

The Community Health Service (CHS) of the Department of Health, Education, and Welfare has been assigned the responsi-

bility of providing health care services to migrant farmworkers. Since poor sanitation can be a major factor in the health of migrants, CHS requested NBS' Technical Analysis Division (TAD) to perform a field survey of the current state of the sanitary conditions of migrant housing.

A survey form was developed by TAD as an aid in evaluating migrant housing. The form was derived from the checklist procedure employed by sanitarians to determine whether migrant housing meets state and local housing regulations.

Field visits were made to migrant labor camps in five different regions of the United States. These regions were selected because they contained a large number of camps open at the time of the visits. Within each region, camps were selected on a modified random basis.

A description of the findings of the survey is provided in both tabular and narrative form. A discussion of the limitations in the procedures used in conducting the survey is also included, and changes are suggested which could be incorporated into future surveys.

**13788.** Holberton, F. E., Parker, E. G., **NBS Fortran test programs version 1 and version 3,** *NBSIR 73-250,* 267 pages (June 1973). (Available as COM73-11955 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Computer programming language; FORTRAN; language validation; standard FORTRAN; test program design.

The NBS FORTRAN test programs, written in Standard FORTRAN, are designed to test whether a FORTRAN compiler accepts the forms and interpretations of the FORTRAN language as described in the American National Standard FORTRAN document × 3.9 — 1966. The test programs are recorded on magnetic tape in approximately 14,500 punch card images, and comprise 116 test units. The test units may be used as separate executable FORTRAN programs, or may be linked end to end with other test units, with a minimum of user effort, to improve operating efficiency. An additional copy of these 116 test units structured into 14 executable programs and the documentation supporting the test programs are included in the distribution.

The test program design criteria was to: (1) Constrain all test programs to the FORTRAN Standard × 3.9 — 1966; (2) Reduce the effect of those areas in which the FORTRAN Standard does not prescribe a method or solution, e.g., range, precision, size of computer, etc.; (3) Simplify the use of the FORTRAN test programs; (4) Test FORTRAN language elements before they are used in support of other tests; (5) Maintain an open ended system so that tests may be changed or added.

The test programs require the use of a card reader, printer and one intermediate unit.

**13789.** Shives, T. R., Willard, W. A., **MFPG detection, diagnosis, and prognosis,** *NBSIR 73-252,* 266 pages (Sept. 1973). (Available as AD772082 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Condition monitoring; failure detection; failure diagnosis; failure prevention; failure prognosis; diagnostic systems.

These proceedings consist of a group of sixteen submitted papers and discussions from the 18th meeting of the Mechanical Failures Prevention Group which was held at the National Bureau of Standards on November 8-10, 1972. Failure detection, diagnosis, and prognosis represent the central theme of the proceedings. Bearing condition monitoring, diagnostic systems technology and applications, and new approaches in sensing and processing are discussed.

**13790.** Son, B. C., **Fire endurance tests of unprotected wood-floor constructions for single-family residences,** *NBSIR 73-263,* 65 pages (July 1973). (Available as PB225-284 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Fire endurance; fire test; flame through; full scale; housing; Operation BREAKTHROUGH; single family residence; small scale; thermal resistance; wood floor; wood joist.

Fire endurance tests were performed on two full-scale and twelve small scale wood floor constructions. The fire endurance ratings on unfinished wood joist and plywood subfloor constructions varied from 10 to 13 minutes and were mainly determined by the time to "flame through." In small-scale tests, the addition of carpeting with a hair pad delayed the time of "flame through" approximately 8 minutes. Time to "flame through" may be estimated from the thermal resistance of the construction, and may be modified by the effects of applied load or construction details such as gaps, joints, and penetrations.

**13791.** Son, B. C., Fang, J. B., **Fire spread on exterior walls due to flames emerging from a window in close proximity to a reentrant wall corner,** *NBSIR 73-266,* 35 pages (Apr. 1973). (Available as PB225-286 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Exterior wall; fire spread; fire test; ignition; Operation BREAKTHROUGH; reentrant corner.

As a part of the research program concerning the recommended criteria for fire safety in Operation BREAKTHROUGH, two full scale fire tests were performed on a mockup of a reentrant corner, i.e., the interior corner formed at the intersection of the exterior walls of adjacent buildings, such as townhouses and garden apartments.

In each test, two wall specimens representing exterior walls were erected perpendicular to a wall containing a window opening into a fire room. One wall was located 1 foot east and the other one 5 feet west of the edges of the window. The objective of the reentrant corner fire test was to study the potential ignition and spread of fire from the room to an adjacent exterior combustible wall.

In the first test, charring on the east wall, but no surface ignition was observed during the test. The peak temperature measured did not exceed 350 °C (660 °F). In the second test, surface ignition occurred on the east wall 9 minutes after the wood crib, representing the combustible contents of the room, was ignited. No significant changes were observed on the west wall during either test.

The instantaneous heat flux incident on the east wall just prior to ignition and the total heat energy absorbed were estimated to be on the order of 1.0 W/cm$^2$ and 175 Joules/cm$^2$ respectively.

**13792.** Issen, L. A., **Report of fire tests on flexible connectors in HVAC systems,** *NBSIR 73-267,* 67 Pages (July 1973). (Available as COM73-11955 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Aluminum; ductwork; fabric; fiberglass; fire tests; high rise buildings; HVAC systems; steel; terminal units.

The contemporary high rise building with its control air conditioning system and high content of synthetic materials presents a higher hazard than those erected prior to 1950. The ability of the duct work to resist fire breaking into it and spreading through the duct system is an important factor affecting the integrity of the building. Since they penetrate fire barriers, the flexible connectors between the main ducts and the terminal units are impor-

tant elements in maintaining the desired fire resistance. Flexible connectors made of four different materials (aluminum, galvanized steel, felted fiberglass and woven fiberglass fabric) and two attachment techniques were subjected to fire tests in accordance with ASTM E119. The results show that the materials of the connectors must withstand the fire exposure, the connectors must remain tightly attached to the main duct, and the penetrations through the fire barrier must be suitably blocked in order to prevent fire from breaking into the duct system. The tests also showed that rubber and plastic materials in the terminal units can produce significant amounts of irritating smoke.

**13793.** Feldman, A., Horowitz, D., Waxler, R. M., **Laser damage in materials,** *NBSIR 73-268,* 44 pages (Aug. 1973). (Available as AD768-303 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Absorption coefficient; calcite; damage threshold; deuterated potassium dihydrogen phosphate; electrostriction; electrostrictive self-focusing; inclusion damage; Kerr effect; laser damage; lithium niobate; nonlinear index of refraction; potassium dihydrogen phosphate; self-focusing; thermal self-focusing; thoria:yttrium oxide ceramic; yttrium aluminum garnet.

Neodymium:glass laser induced damage is observed in lithium niobate ($LiNbO_3$), calcite ($CaCO_3$), potassium dihydrogen phosphate (KDP), and deuterated potassium dihydrogen phosphate (KD*P). The damage at the lowest power levels is caused by inclusions. At higher power levels, filamentary damage, which is indicative of self-focusing, is observed in $LiNbO_3$. An analysis of self-focusing data in yttrium aluminum garnet shows that the Kerr effect is the dominant self-focusing mechanism, with some contribution from the thermal effect. Bulk and surface damage thresholds in neodymium-doped thoria:yttrium oxide ceramic are obtained relative to bulk damage thresholds in several optical materials. For solid materials relationships are obtained between the stress-optic coefficients and the electrostrictive coefficients under different geometric boundary conditions.

**13794.** McNeil, M. B., **Report to AID on an NBS/AID workshop on standardization and measurement services in industrializing economics,** *NBSIR 73-275,* 64 pages (May 4-18, 1973). (Available as COM74-10126 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: AID; assistance; economics; foreign relations; industrializing nations; LDC's; measurement services; standardization.

On May 4-18, 1973, a Workshop was held at the National Bureau of Standards (Gaithersburg), under the sponsorship of AID, whose object was to give standards officials of industrializing nations insight into the standards and measurement systems in the United States and the role of the National Bureau of Standards, so that these officials might consider what parts of the U.S. system might usefully be adapted to conditions in their home countries. The report contains copies of speeches and presentations by representatives of both the U.S. and the industrializing nations, in addition to a general agenda of talks, presentations, and tours of laboratories both of NBS and of other organizations.

**13795.** Fung, F. C. W., **Evaluation of a pressurized stairwell smoke control system for a 12 story apartment building,** *NBSIR 73-277,* 53 pages (June 1973). (Available as PB225-278 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Analysis; basic correlation formulas; computer calculations; high-rise building fire; Operation BREAKTHROUGH; pressurized stairwell; quantitative experiment; smoke control; smoke simulation.

An NBS study to evaluate the effectiveness of a pressurized stairwell smoke control system in a high rise apartment building is summarized and discussed in the light of experimental results, analysis, and computer prediction. A quantitative experimental technique of smoke simulation and smoke movement measurement is described, supplemented by basic physical laws necessary for correlation with small fires, and illustrated by the results of an actual field experiment. Experiments were conducted in a 12 story apartment building constructed on the Operation BREAKTHROUGH prototype site in St. Louis, Missouri. The experimental results are then further extended to a wider range of ambient weather conditions by way of computer prediction calculations. General conclusions and relevant recommendations as a result of the study are also presented.

**13796.** Trechsel, H. R., **Swiss building and housing research activities,** *NBSIR 73-288,* 63 pages (Aug. 1973). (Available as COM73-11861 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Building research; buildings; cooperation; housing; international; Switzerland.

Following up earlier contacts of CBT management with representatives of Swiss building research organizations, the author visited Switzerland in the Fall of 1972 for two weeks.

This report discusses the results of meetings with representatives of the Swiss Federal Commission for Housing Research (FKW), major educational and research establishments, architects, contractors, builders, and local building officials. Topics covered in the discussions included building economics, modular coordination, pre-evaluation of performance of housing projects, pre-evaluation of research projects, building design, land use and planning, transportation, and building laws, codes, and standards.

It appears that cooperative programs in any or all of these areas could be profitable to NBS, and to the corresponding Swiss organizations.

**13797.** Treu, S., **Characterization and testing of interactive graphics for computer-aided design and engineering,** *NBSIR 73-289,* 36 pages (June 30, 1973). (Available as COM74-10475 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Characteristics; computer-aided design; interactive graphics; man-machine interaction; performance measurement.

This report presents material developed as part of a long-term "Interactive Computer-Aided Techniques Study." The report outlines the stages of development in the utilization of interactive graphics as a tool for Computer-Aided Design and Engineering (CAD/E). A series of characteristics are presented which are of significance to the designers and users of such systems and a series of questions of evaluative interest posed. These questions are intended to delineate the extent to which a system under examination achieves its stated design objectives. The characteristics are grouped in accordance with the nature and complexity of the experiments which would need to be conducted to establish values for them. The report suggests selected characteristics of particular interest and suggests the design of experiments for examining them in detail. The report makes specific reference to the MEDEA design terminal concept under development within the Graphical Systems and Technology Branch of ECOM.

**13798.** Clifton, J. R., Beeghly, H. F., Mathey, R. G., **Interim Report No. 7. Chemical resistance and physical durability testing of coating materials,** *NBSIR 73-295,* 22 pages (Aug. 1973). (Available as COM74-10471 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Bridge decks; corrosion; creep testing; epoxy coatings; polyvinylchloride coatings; steel reinforcing bars.

The possibilities of protecting steel reinforcing bars embedded in concrete of bridge decks from corrosion by using organic barrier-type coatings are being investigated in this project. This corrosion is accelerated by the chloride ions of the two most commonly applied deicing materials, sodium chloride and calcium chloride.

In this report, physiochemical studies performed on coatings and coated bars are discussed, including: immersion studies of coatings in corrosive solutions; impact and embedded in concrete.

**13799.** Andrews, J. R., **Random sampling oscilloscope time base,** *NBSIR 73-309,* 86 pages (June 1973). (Available as COM73-11981 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Mercury switch; oscilloscope; picosecond; pulse; random sampling; risetime; sampling; time base; transition time.

With the advent of new miniaturized mercury (Hg) switches with reputed transition times of the order of 10 picoseconds, interest has been rekindled in their use in high speed pulse measurements. Since there is no pre-trigger signal available from a Hg switch, normal sequential sampling techniques are not usable to measure the fast Hg switch transition time. For this reason a new random sampling time base unit was designed to perform these measurements at the low repetition rate of Hg switches ($<$ 100 Hz). The time base may be used with commercial sampling oscilloscope systems through suitable interconnection terminals or possible interface equipment. It features three selectable time windows of 1 $\mu$s, 100 ns, and 10 ns. Using its time magnifier, the fastest sweep rate is 10 ps/cm. A variable trigger lead time control is provided. The trigger sensitivity is 10 mV. The long term timing stability of the time base is excellent with less than 15 ps/h drift.

**13800.** Kartaschoff, P., Jarvis, S., Jr., **Notes on infrared absorption experiments in a methane molecular beam,** *NBSIR 73-312,* 32 pages (May 1973). (Available as COM73-11893/7AS from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Frequency standard; methane resonance; molecular beam; Ramsey resonance; saturated absorption; stabilized laser; transition probability.

The problem of calculating the transition probability of methane molecules in a molecular beam interacting with an infrared (3.39 $\mu$) radiation beam is discussed. Contrary to the usual microwave molecular beam experiments, first-order Doppler frequency shifts cannot be neglected. This makes the solution of the wave-equations more difficult. Weak field approximations to the transition probability have been calculated. Single optical beam experiments analogous to the Rabi-type interaction result in a Doppler-broadened absorption line with an estimated half-power width of a few MHz. For separated multiple field experiments analogous to the Ramsey-type interaction, no observable response is predicted, the expected sharp resonance pattern being smeared out by the random Doppler shifts due to the spread of the molecular beam trajectories. Further investigations are required in order to predict the resonance line shapes for strong fields, i.e., saturated absorption.

**13801.** Woolley, M. L., **Bibliography of the Electromagnetics Division June 30, 1972 to June 30, 1973,** *NBSIR 73-320,* 22 pages (June 1973). (Available as COM73-11971 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Antenna parameters; attenuation; current; electromagnetic measurements; field strength; impedance; waveguide theory.

This bibliography lists the publications of the NBS Electromagnetics Division between June 30, 1972 and June 30, 1973.

**13802.** Unassigned.

**13803.** Parrish, W. R., Hiza, M. J., **Calculated liquid phase thermodynamic properties and liquid-vapor equilibria for fluorine-oxygen (FLOX) mixtures,** *NBSIR 73-338,* 30 pages (Sept. 1973). (Available as COM73-11660 from the National Technical Information Service, Springfield, Va. 22151.)

Key words: Calculated thermophysical properties; compressed liquid phase, fluorine-oxygen mixtures, hard-sphere model; liquid-vapor equilibria.

Liquid phase thermodynamic properties and liquid-vapor equilibria of fluorine-oxygen mixtures, for which no experimental data exist, have been calculated. The results are based on excess properties predicted from the Snider-Herrington equations, with an adjusted combining rule, and the corresponding data for the pure fluids. Mixtures considered are 0.6, 0.7, 0.8, 0.88, and 0.9 weight fraction of fluorine from 55 to 90 K up to $70 \times 10^5$ Pa. In the compressed liquid, molar volumes, enthalpy, entropy, and constant pressure specific heat were determined. Along the saturation boundary, coexistent vapor compositions and solution vapor pressures were determined as well. Corresponding properties of pure fluorine from experimental data have also been included. Results are tabulated in both British and S.I. units.

# 5. INDEXES

## 5.1. HOW TO USE THE INDEXES

In addition to the usual author index, a subject index is provided in the form of a permuted key word index. In this type of index the key words in each publication or paper are arranged by shifting each group of key words along the horizontal printing line so that each key word in turn has an opportunity to appear alphabetically. The user is thus able to locate papers of interest to him through the subject-related words he finds in the key word index.

The index symbols used in the author and key word indexes are explained in the following three tables. These tables also give the pages on which the abstracts of the various publication series begin.

Table A. Symbols for the Periodicals

| NBS Journal of Research | Index Symbol | | | Issue Date | Page Number |
|---|---|---|---|---|---|
| | Vol. | Sec. | No. | | |
| Section A | J77 | A | 1 | January–February 1973 | 21 |
| | J77 | A | 2 | March–April 1973 | 23 |
| | J77 | A | 3 | May–June 1973 | 24 |
| | J77 | A | 4 | July–August 1973 | 25 |
| | J77 | A | 5 | September–October 1973 | 26 |
| | J77 | A | 6 | November–December 1973 | 27 |
| Section B | J77 | B | 1 & 2 | January–June 1973 | 29 |
| | J77 | B | 3 & 4 | July–December 1973 | 29 |

| DIMENSIONS/NBS* | Index Symbol | | Issue Date | Page Number |
|---|---|---|---|---|
| | Vol. | No. | | |
| TNB | 57 | 1 | January 1973 | 32 |
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| DIM | 57 | 12 | December 1973 | 34 |

* Name changed with the August 1973 issue.

Table B. Symbols for the Nonperiodicals

| NBS Nonperiodical Series | Index Symbol | Page Number |
|---|---|---|
| Monographs | Monogr. | 35 |
| Handbooks | H | 37 |
| Special Publications | SP | 38 |
| Applied Mathematics Series | AMS | 50 |
| National Standard Reference Data Series | NSRDS | 50 |
| Building Science Series | BSS | 51 |
| Federal Information Processing Standards | FIPS PUBS | 53 |
| Product Standards | PS | 54 |
| Technical Notes | TN | 55 |
| Consumer Information Series | CIS | 69 |
| NBS Interagency Reports | NBSIR | 70 |

Table C. Symbols for the Papers Published by Others (1973)

| NBS Papers Published by Others (1973) | Index Symbol | Page Number |
|---|---|---|
| Professional Journals, Books, Book Chapters, Proceedings, etc. | Five-Digit numbers, 13058 through 13803 | 73 |

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Prosen, E. J., Kilday, M. V., *J.77A No. 5, 581-597 (1973).*
Prosen, E. J., Wagman, D. D., Kilday, M. V., *J.77A No. 2, 217-225 (1973).*
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Water vapor; Interaction virial coefficients; Moist air; Second virial coefficient; Virial coefficients; *J.77A No. 1, 133-147 (1973)*.
Water vapor discharge; Water vapor laser; Infrared laser; Vibrational excitation; *13623*.
Water vapor laser; Infrared laser; Vibrational excitation; Water vapor discharge; *13623*.
Water vapor permeance; Abrasion; Adhesion; Colorfastness; Covering; Materials; Flash point; Flame spread; Impact resistance; Lead paint poisoning; Materials; Performance; Properties; Scratch resistance; Smoke generation; Toxic combustion products; *TN808*.
Waterdrop; Drop generator; Liquid drop; *TN776*.
Water-flow regulation; Performance characteristics; Refrigeration accessories; Valves; *13549*.
Waveguide joints; Waveguide theory; Attenuation definitions; Attenuation measurement; Barretter mount efficiency; Coaxial connectors; Impedance measurement; Microwave network theory; Mismatch errors; Phase shift-measurement; Power measurement; *Monogr. 137*.
Waveguide theory; Antenna parameters; Attenuation; Current; Electromagnetic measurements; Field strength; Impedance; *13801*.
Waveguide theory; Attenuation definitions; Attenuation measurement; Barretter mount efficiency; Coaxial connectors; Impedance measurement; Microwave network theory; Mismatch errors; Phase shift-measurement; Power measurement; Reflectometers; *Monogr. 137*.
Wavelength; Wavelength standards; Interferometry; Laser; Methane; Saturated absorption; *13228*.
Wavelength standards; Interferometry; Laser; Methane; Saturated absorption; Wavelength; *13228*.
Wavelengths; Cerium; Ce II; Energy levels; Spectrum; *J.77A No. 4, 419-546 (1973)*.
Wavelengths; Energy levels; Spectrum; Thulium; *J.77A No. 1, 1-43 (1973)*.
Wavelengths; Magnesium; Source; Spectra; Ultraviolet; *13370*.
Wavelengths; Molybdenum; Spectra; Ultraviolet; *13085*.
Wavelengths; Niobium; Spectra; Ultraviolet; *13083*.
Wavelengths; Zeeman effect; Rubidium; Spectra; Ultraviolet; *13196*.
Wavelengths; Zeeman effect; Rubidium; Spectra; Ultraviolet; *13662*.
Wavelengths; Zirconium; Spectra; Ultraviolet; *13084*.
Weak interaction; Beta decay; Carbon; Electromagnetic; Form factor; Muon; Neutrino; *13125*.
Weak interaction; Lepton; *m*-spin; Neutrino; $SU(2)_M \times SU(2)_I$; Trident production; *13127*.
Weapons radiation; Benchmark problems; Dose distributions; Moments method; Neutron penetration; Shielding; *TN745*.
Weather resistance; Accelerated tests; Acid resistance; Aluminum; Color; Gloss; Porcelain enamel; Steel; *13715*.
Weather resistance; Color; Gloss; Porcelain enamel on aluminum; *13383*.
Weathering of plastics; Manufacturing Chemists' Association (MCS); Performance of plastics outdoors; Plastics; *13399*.
Weathering tests; Non-dispersive x-ray spectrometer; Corrosion; Pinhole-type defects; Porcelain enamel; Scanning electron microscope; *13714*.
Wedge; Disclination; Dislocation; Glide; Plasticity; Twist; Volterra; *13271*.
Wedged optical surfaces; Dye laser continua; High resolution; Interferometric effects; Optical components; Organic dye lasers; *13678*.
Wedges; Anechoic chamber design; Plane-wave tubes; *13078*.
Weighted fit; Astrophysical interest; Centrifugal distortion; Formamide; Microwave spectrum; Quadrupole splittings; Rotational transitions; *13218*.
Weights; Index; Measures; National Conference; Reports; *SP377*.
Weights and measures; Metric system; SI; *C1S7*.
Weights and measures; Administration; Conference; Laws; Procedures; Regulations; Requirements; Technology; *SP379*.
Weyl's Theorem; Convex hull; Unit circle; *J.77B Nos. 3 and 4, 137-141 (1973)*.
Wind; Air inlet; Discomfort index; Draft; Outside wall; Ventilation; *TN710-6*.
Wind direction; Wind speed; Air contamination; Design conditions; Earthquake risk; Evaluation; Ground temperature; Humidity; Noise level; Operation BREAKTHROUGH; Precipitation; Solar radiation; Temperature; *13398*.
Wind effects; Building; Earthquakes; Hazards; Land use; Structural engineering; *BSS46*.
Wind load; Wood frame construction; Building damping; Drift; Dynamics; Earthquake; Frequency; Housing; Lateral resistance; Racking; Stiffness; Structural deflections; Vibration; *BSS44*.
Wind speed; Air contamination; Design conditions; Earthquake risk; Evaluation; Ground temperature; Humidity; Noise level; Operation BREAKTHROUGH; Precipitation; Solar radiation; Temperature; Wind direction; *13398*.
Wind-generated noise; Acoustic attenuation; Foam windscreens; *13726*.
Window coatings; KCl; AnSe; CdTe; $CO_2$ laser damage; Damage thresholds; Laser windows; *SP387*, pp. 151-156
Wire bond; Bonding; Electrical connection; Failure (wire bond); Integrated circuits; Microelectronics; Reliability; Semiconductor devices; Testing (wire bond); *TN786*.
Wire bond; Aluminum wire; Bonding; Fabrication (wire bonds); Microelectronics; Ribbon wire; Round wire; Testing (wire bond); Ultrasonic bonding; *TN767*.

Wire bonding; Aluminum wire; High reliability; Integrated circuit; Metallization; Scanning electron microscope; Transistor; Ultrasonic bonding; *TN785*.

Wire bonds; Aluminum wire; Base transit time; Carrier lifetime; Die attachment; Electrical properties; Epitaxial silicon; Gamma-ray detectors; Generation centers; Germanium; Gold-doped silicon; Infrared response; Methods of measurement; *TN754*.

Wire bonds; Base transit time; Carrier lifetime; Delay time; Die attachment; Electrical properties; Electronics; Epitaxial silicon; Four-probe method; Generation centers; Germanium; Gold-doped silicon; Infrared response; Methods of measurement; *TN773*.

Wire bonds; Base transit time; Carrier lifetime; Delay time; Die attachment; Electrical properties; Electronics; Epitaxial silicon; Four-probe method; Generation centers; Germanium; Gold-doped silicon; Infrared response; Methods of measurement; *TN788*.

Wire bonds; Beam leads; Carrier lifetime; Delay time; Die attachment; Electrical properties; Electronics; Epitaxial silicon; Generation centers; Gold-doped silicon; Methods of measurement; Microelectronics; Microwave diodes; Mobility; Pull test; *TN806*.

Wood; Wood joists; Concentrated loads; Deflection; Floor hardboard; Housing; Impact energy; Operation BREAKTHROUGH; Plywood; Subfloors; Underlayment; *13472*.

Wood floor; Wood joist; Fire endurance; Fire test; Flame through; Full scale; Housing; Operation BREAKTHROUGH; Single family residence; Small scale; Thermal resistance; *13790*.

Wood frame construction; Building damping; Drift; Dynamics; Earthquake; Frequency; Housing; Lateral resistance; Racking; Stiffness; Structural deflections; Vibration; Wind load; *BSS44*.

Wood joist; Fire endurance; Fire test; Flame through; Full scale; Housing; Operation BREAKTHROUGH; Single family residence; Small scale; Thermal resistance; Wood floor; *13790*.

Wood joists; Concentrated loads; Deflection; Floor hardboard; Housing; Impact energy; Operation BREAKTHROUGH; Plywood; Subfloors; Underlayment; Wood; *13472*.

Wood pulp; Aluminum; Calcium; Carboxylic acid; Cellulose; Differential thermal analysis; Hemicellulose; Ion exchange; PH; Pyrolysis; Thermal stability; Thermogravimetric analysis; *13109*.

Wood-frame; Deflection; Housing; Laboratory; Module; Racking; Stiffness; Strength; Structural tests; Sustained load; Transportation; Vibration; *13389*.

Wood-frame construction; Concentrated-load capacity; Evaluation criteria; Floors; Hardboard; Load capacity; Operation BREAKTHROUGH; Performance criteria; Plywood subflooring; Subflooring; Underlayment; *13388*.

World Meteorological Organization; International Pyrheliometric Scale; Irradiance; Pyrheliometer; *13555*.

W-Re alloys; W-Re type thermocouples; W-Re thermoelements; Beryllium oxide; Ductility; Emf-temperature relationship; Microstructure; Thermocouple drift; *13585*.

W-Re thermoelements; Beryllium oxide; Ductility; Emf-temperature relationship; Microstructure; Thermocouple drift; W-Re alloys; W-Re type thermocouples; *13585*.

W-Re type thermocouples; W-Re thermoelements; Beryllium oxide; Ductility; Emf-temperature relationship; Microstructure; Thermocouple drift; W-Re alloys; *13585*.

Wring test; End length standards; Gage blocks; Joining; Wringing; *J.77A No. 5, 667-670 (1973)*.

Wringing; Wring test; End length standards; Gage blocks; Joining; *J.77A No. 5, 667-670 (1973)*.

Written language; Human communication; Language; Meaning; Symbols; Understanding; *13233*.

Wurtzite-type; Chalcopyrite-type; Silver indium sulfide; Spinel-type; *13251*.

## X

X rays; Radiation safety; Radiography; Voluntary standards; *13482*.

X-F bonds; Fluorine; Polarization of bonds; Proton assisted reactions; *13368*.

X-ray absorption of sulphur *K*, *L* and fluorine *K*; X-ray emission of sulphur $K\alpha$, $K\beta$, *L* and fluorine $K\alpha$; Molecular orbital model; Photon and electron excited emission spectra; Resonance radiation; *13101*.

X-ray diffraction; Liquid; Liquid structure factor; Neutron diffraction; Pair correlation function; Radial distribution function; *13114*.

X-ray emission of sulphur $K\alpha$, $K\beta$, *L* and fluorine $K\alpha$; Molecular orbital model; Photon and electron excited emission spectra; Resonance radiation; Semi-Auger process; $SF_6$; *13101*.

X-ray fluorescence; Air pollution; Atomic absorption; Electron microprobe; Emission spectroscopy; Environmental analysis; Industrial effluents; Ion-selective electrodes; Nuclear activation analysis; Particulate analysis; Polarography; *13783*.

X-ray fluorescence spectrometry; Standard Reference Material; Analytical standard; Atomic absorption spectrometry; Differential cathode ray polarography; Electrodeposition; Lead-based paint; Neutron activation analysis; *SP260-45*.

X-ray measurement; Data reduction; Electron probe; Errors; Microanalysis; *13560*.

X-ray microanalysis; Deposited thin film; Electron beam metal deposition; Scanning electron microscopy; *13775*.

X-ray opacity; Barium glass; Dental composites; Dental reinforcements; Physical properties; Resins; Silica; *13674*.

X-ray photoemission; Aluminum; Auger transitions; Copper; Electronic density of states; Nickel; Secondary-electron energy distribution; *13058*.

X-ray photoemission; Aluminum; Auger transitions; Copper; Electronic density of states; Nickel; Secondary-electron energy distribution; *13145*.

X-ray photoemission; Aluminum; Auger-transitions; Copper; Electronic density of states; Nickel; Photoelectron energy distribution; Secondary-electron energy distribution; *13483*.

X-ray spectrometry; Coating thickness; Electroplating; Fluorescent x-rays; Thickness; *13203*.

X-rays; Accelerator; Blood irradiators; Dosimetry; Electron beams; Gamma rays; Radiochromic dyes; *13630*.

X-rays; Photoelectron spectra; Potassium; Rubidium; Sodium; *13357*.

## Y

YAG; Birefringence; Fused silica; Optical spectrum analyzer; Photoelastic effect; Sapphire; Scanning Fabry-Perot interferometer; *SP387*, pp. 254-258

*Y*-factor; Analysis; Automation; Noise figure; *13199*.

Youden, W. J; Experiment design; Interlaboratory tests; Statistics; *13137*.

Young's modulus; Alumina; Elastic modulus; Resonance frequency; Shear modulus; Standard reference material; *J.77A No. 4, 391-394 (1973)*.

Ytterbium; Cerium; Dysprosium; Erbium; Europium; Gadolinium; Hafnium; Holmium; Ionization energy; Lanthanum; Lutetium; Neodymium; Praseodymium; Promethium; Samarium; Terbium; Thulium; *13703*.

Ytterbium; Energy levels; Spectrum; *13660*.

Ytterbium compounds; Cerium compounds; Dysprosium compounds; Enthalpy; Entropy; Erbium compounds; Europium compounds; Gadolinium compounds; Gibbs energy of forma-

tion; Holium compounds; Lanthanides; Lanthanum compounds; Lutetium compounds; *TN270-7.*

Yttrium aluminum garnet; Absorption coefficient; Calcite; Damage threshold; Deuterated potassium dihydrogen phosphate; Electrostriction; Electrostrictive self-focusing; Inclusion damage; Kerr effect; Laser damage; Lithium niobate; *13793.*

Yttrium aluminum garnet; Absorption coefficient; Electrostriction; Kerr effect; Laser damage; Nonlinear refractive index; Optical glasses; Self-focusing; Thermal self-focusing; *SP387, pp. 26-35*

Yttrium aluminum garnet; Ellipse rotation; Glass; Nonlinear index; Nonlinear susceptibility; Self focusing; *SP387,* pp. 11-24

Yugoslavia science and technology; Binational research cooperation; International scientific cooperation; Physical science research administration; Research planning; Scientific research abstracts; Special Foreign Currency Program; *TN753.*

## Z

Zeeman effect; Air pollution; Infrared spectroscopy; Lasers; Nitric oxide; *13079.*

Zeeman effect; $Cr^{3+}$ in $TiO_2$; Identification of excited state; $^4A_{2g}$ - $^4T_{2g}$ transition; *13548.*

Zeeman effect; Rubidium; Spectra; Ultraviolet; Wavelengths; *13196.*

Zeeman effect; Rubidium; Spectra; Ultraviolet; Wavelengths; *13662.*

Zero gravity; Boiling heat transfer; Bubble dynamics; Cavitation; Condensing heat transfer; Correlations; Cryogenic fluid safety; Fluid dynamics; Fluid transfer; Heat transfer; Heat transfer equipment; Liquid helium; Liquid hydrogen; Liquid nitrogen; *13242.*

Zinc; Cadmium; Mercury; Spectra; *13150.*

Zintl phases; Chemical bonding; Phase stabilization; Pseudopotential; *13213.*

Zirconium; Aluminum; Composites; Coupling agents gold; Mercaptan; Methacrylates; Polymers; Resin; Silane; Tantalum; *13620.*

Zirconium; Spectra; Ultraviolet; Wavelengths; *13084.*

ZnSe; $ZnSe_xTe_{1-x}$; Absorption coefficient; Emittance spectra; KBr; CdTe; *SP387,* pp. 250-253

$ZnSe_xTe_{1-x}$; Absorption coefficient; Emittance spectra; KBr; CdTe; ZnSe; *SP387,* pp. 250-253

ZnTe; $As_2S_3$; CdTe; Dielectric reflector; Inclusions in dielectrics; KCl; Pulsed $CO_2$ laser damage; Thin film damage; *SP387,* pp. 157-169

$ZrF_2$, $ZrF_3$, $ZrF_4$, $CaF_2$; Entropy; Geometry; Infrared spectra; Matrix isolation; Stability; *13567.*

0.694 $\mu$m; $Ag_3AsS_3$; Proustite; Pulse duration dependence; Repetition rate dependence; Surface damage; 1.06 $\mu$m; *SP387,* pp. 239-249

$1^+$ state; 15.11 MeV; Electron scattering; Extrapolation, $\Gamma_\gamma$; Low $q^2$; *13658.*

$^1\Delta O_2$; Lasers; Photochemistry; Photooxidation; *13300.*

1.06 $\mu$m; 0.694 $\mu$m; $Ag_3AsS_3$; Proustite; Pulse duration dependence; Repetition rate dependence; Surface damage; *SP387,* pp. 239-249

$^{109}$Ag Knight shift; Absorption derivative; Alloys; Asymmetry; Host; Lineshape; *13381.*

119; 78 $\mu$m; $H_2O$ laser; Laser magnetic resonance; Laser spectroscopy; $O_2$; *13198.*

1,2-hydride shift; Ion-molecule reactions; Ionic structure; Photoionization; Alkyl halides; Ethyl cations; *13235.*

14 MeV neutron activation; Counting precision; Excess variability; Limiting precision; Photonuclear chemistry; Poisson statistics; Single and multiple parameter nuclear analyses; Statistical weights; *13694.*

$^{14}$C; Electron scattering; E2 excitations; Transition radii; *13225.*

15.11 MeV; Electron scattering; Extrapolation, $\Gamma_\gamma$; Low $q^2$; $1^+$ state; *13658.*

$^{19}$F; $^{40}$Ca; Transition strengths; Electron scattering; Inelastic; *13723.*

1967 Amendments to the Flammable Fabrics Act; Flammable fabrics; Flammability standards; National Advisory Commission for the Flammable Fabrics Act; *13362.*

2 MeV electron accelerator; Charge monitor; High frequency; Integrator; Low current monitor; *13148.*

2*e*/*h* measurements; As-maintained; International comparisons; Josephson effect; *13239.*

2-factors; Graph theory; Hamiltonian circuits; Hamiltonian connected; Powers of graphs; Combinatorics; Connectivity; Euler graphs; *J.77B Nos. 1 and 2, 1-10 (1973).*

$^{22}$Ne; Neon; Vapor pressure; Fixed point; $^{nat}$Ne; $^{20}$Ne; *13601.*

$2^3P$ term of $Li^+$; Electron-excitation cross section; Lifetime; Rf resonance spectroscopy; *13339.*

$^{239}$ Pu; Alpha-particle; Emission; Fission; Neutron; Reactor; *13458.*

3-antenna technique; Antenna gain; Antenna polarization; Extrapolation technique; *13627.*

$^3$He; Pole dominance; Quasifree scattering; Rescattering effects; Separable potentials; Three-body problem; *13126.*

3,6-Dioxabicyclo[3.1.0]hexane; Boat conformation; Dipole moment; Microwave spectrum; Ring conformation; Rotational constants; *13618.*

$^4A_{2g}$ - $^4T_{2g}$ transition; Zeeman effect; $Cr^{3+}$ in $TiO_2$; Identification of excited state; *13548.*

$^{40}$Ca; Transition strengths; Electron scattering; Inelastic; $^{19}$F; *13723.*

4340 steel; Bending; Capacitance strain gage; Tensile; Ti-6Al-4V; Uniaxial loading; *13648.*

$^{60}$Co gamma-ray source; Absorbed dose; Dye-polychlorostyrene film dosimeter; High-intensity pulsed electron source; Thin aluminum calorimeters; *13201.*

78 $\mu$m; $H_2O$ laser; Laser magnetic resonance; Laser spectroscopy; $O_2$; 119; *13198.*

# APPENDIX A. LIST OF DEPOSITORY LIBRARIES IN THE UNITED STATES

## ALABAMA

Alexander City: Alexander City State Junior College, Thomas D. Russell Library (1967).
Auburn: Auburn University, Ralph Brown Draughon Library (1907).
Birmingham:
- Birmingham Public Library (1895).
- Birmingham-Southern College Library (1932).
- Jefferson State Junior College, James B. Allen Library (1970).
- Samford University, Harwell G. Davis Library (1884).

Enterprise: Enterprise State Junior College Library (1967).
Florence: Florence State University, Collier Library (1932).
Gadsden: Gadsden Public Library (1963).
Huntsville: University of Alabama, Huntsville Campus Library (1964).
Jacksonville: Jacksonville State University, Romana Wood Library (1929).
Maxwell A.F. Base: Air University Library (1963).
Mobile:
- Mobile Public Library (1963).
- Spring Hill College, Thomas Byrne Memorial Library (1937).
- University of South Alabama Library (1968).

Montgomery:
- Alabama State Department of Archives and History Library (1884).
- Alabama Supreme Court Library (1884).
- Auburn University at Montgomery Library (1971).

Normal: Alabama Agricultural and Mechanical College, Drake Memorial Library (1963).
St. Bernard: St. Bernard College Library (1962).
Troy: Troy State University, Lurleen B. Wallace Educational Resources Center (1963).
Tuskegee Institute: Tuskegee Institute, Hollis Burke Frissell Library (1907).
University:
- University of Alabama School of Law Library (1967).
- University of Alabama Library (1860)—REGIONAL

## ALASKA

Anchorage:
- Anchorage Community College Library (1961).
- Anchorage Methodist University Library (1963).
- Supreme Court of Alaska Library (1973).

College: University of Alaska, Elmer E. Rasmuson Library (1922).
Juneau: Alaska State Library (1964).
Ketchikan: Ketchikan Community College Library (1970).

## ARIZONA

Flagstaff: Northern Arizona University Library (1937).
Phoenix:
- Department of Library and Archives (unknown)—REGIONAL.
- Phoenix Public Library (1917).

Prescott: Prescott College Library (1968).
Tempe: Arizona State University, Matthews Library (1944).
Thatcher: Eastern Arizona College Library (1963).
Tucson:
- Tucson Public Library (1970).
- University of Arizona Library (1907)—REGIONAL.

Yuma: Yuma City-County Library (1963).

## ARKANSAS

Arkadelphia: Quachita Baptist University, Riley Library (1963).
Batesville: Arkansas College Library (1963).
Clarksville: College of the Ozarks Library (1925).
Conway: Hendrix College, O. C. Bailey Library (1903).
Fayetteville: University of Arkansas Library (1907).
Little Rock:
- Arkansas Supreme Court Library (1962).
- Little Rock Public Library (1953).
- University of Arkansas at Little Rock Library (1973).

Magnolia: Southern State College, J. M. Peace Library (1956).
Monticello: University of Arkansas at Monticello Library (1956).
Russellville: Arkansas Polytechnic College, Tomlinson Library (1925).
Searcy: Harding College, Beaumont Memorial Library (1963).
State College: Arkansas State University, Dean B. Ellis Library (1913).
Walnut Ridge: Southern Baptist College, Felix Goodson Library (1967).

## CALIFORNIA

Anaheim: Anaheim Public Library (1963).
Arcata: Humboldt State College Library (1963).
Bakersfield: Kern County Library (1943).
Berkeley:
- University of California, General Library (1907).
- University of California, Law Library, Earl Warren Legal Center (1963).

Carson: Carson Regional Library (1973).
Chico: Chico State University Library (1962).
Claremont: Pomona College Documents Collection, Honnold Library (1913).
Compton: Compton Library (1972).
Culver City: Culver City Library (1966).
Davis:
- University of California at Davis Library (1953).
- University of California at Davis, School of Law Library (1972).

Downey: Downey City Library (1963).
Fresno:
- Fresno County Free Library (1920).
- California State University Library (1962).

Fullerton: California State College at Fullerton Library (1963).
Garden Grove: Garden Grove Regional Library (1963).
Gardena: Gardena Public Library (1966).
Hayward: California State College at Hayward Library (1963).

Huntington Park: Huntington Park Library, San Antonio Region (1970).
Inglewood: Inglewood Public Library (1963).
Irvine: University of California at Irvine Library (1963).
La Jolla: University of California. San Diego, University Library (1963).
Lakewood: Angelo Iacoboni Public Library (1970).
Lancaster: Lancaster Regional Library (1967).
Long Beach:
- California State College at Long Beach Library (1962).
- Long Beach Public Library (1933).

Los Angeles:
- California State College at Los Angeles, John F. Kennedy Memorial Library (1956).
- Los Angeles County Law Library (1963).
- Los Angeles Public Library (1891).
- Loyola University of Los Angeles Library (1933).
- Occidental College, Mary Norton Clapp Library (1941).
- Pepperdine University Library (1963).
- University of California at Los Angeles Library (1932).
- University of California at Los Angeles, Law Library (1958).
- University of Southern California Library (1933).

Menlo Park: Department of the Interior, Geological Survey Library (1962).
Montebello: Montebello Library (1966).
Monterey: Naval Postgraduate School Library (1963).
Monterey Park: Bruggemeyer Memorial Library (1964).
Northridge: California State University at Northridge Library (1958).
Oakland:
- Mills College Library (1966).
- Oakland Public Library (1923).

Pasadena:
- California Institute of Technology, Millikan Memorial Library (1933).
- Pasadena Public Library (1963).

Pleasant Hill: Contra Costa County Library (1964).
Redding: Shasta County Library (1956).
Redlands: University of Redlands, Armacost Library (1933).
Redwood City: Redwood City Public Library (1966).
Reseda: West Valley Regional Branch Library (1966).
Richmond: Richmond Public Library (1943).
Riverside:
- Riverside Public Library (1947).
- University of California at Riverside Library (1963).

Sacramento:
- California State Library (1895)—REGIONAL.
- Sacramento City-County Library (1880).
- Sacramento County Law Library (1963).
- Sacramento State College Library (1963).

San Bernardino: San Bernardino County Free Library (1964).
San Diego:
- San Diego County Library (1966).
- San Diego Public Library (1895).
- California State University, San Diego, Love Library (1962).
- San Diego County Law Library (1973).
- University of San Diego Law Library (1967).

San Francisco:
- Mechanics' Institute Library (1889).
- San Francisco Public Library (1889).
- San Francisco State College, Social Science and Business Library (1955).
- Supreme Court of California Library (1972).
- U.S. Court of Appeals for Ninth Circuit Library (1971).
- University of San Francisco, Richard A. Gleeson Library (1963).

San Jose: San Jose State College Library (1962).
San Leandro: San Leandro Community Library Center (1961).
San Luis Obispo: California State Polytechnic University Library (1969).
Santa Ana: Santa Ana Public Library (1959).
Santa Barbara: University of California at Santa Barbara Library (1960).
Santa Clara: University of Santa Clara, Orradre Library (1963).
Santa Cruz: University of California at Santa Cruz Library (1963).
Santa Rosa: Santa Rosa-Sonoma County Public Library (1896).
Stanford: Stanford University Libraries (1895).
Stockton: Public Library of Stockton and San Joaquin County (1884).
Thousand Oaks: California Lutheran College Library (1964).
Torrance: Torrance Civic Center Library (1969).
Turlock: Stanislaus State College Library (1964).
Valencia: Valencia Regional Library (1972).
Van Nuys: Los Angeles Valley College Library (1970).
Visalia: Tulare County Free Library (1967).
Walnut: Mount San Antonio College Library (1966).
West Covina: West Covina Library (1966).
Whittier: Whittier College, Wardman Library (1963).

## CANAL ZONE

Balboa Heights: Canal Zone Library-Museum (1963).

## COLORADO

Alamosa: Adams State College Learning Resources Center (1963).
Boulder: University of Colorado Libraries (1879)—REGIONAL.
Colorado Springs: Colorado College, Charles Leaming Tutt Library (1880).
Denver:
- Colorado State Library (unknown).
- Denver Public Library (1884)—REGIONAL.
- Department of Interior, Bureau of Reclamation Library (1962).
- Regis College, Dayton Memorial Library (1915).
- University of Denver, Mary Reed Library (1909).
- U.S. Court of Appeals, Tenth Circuit Library (1973).

Fort Collins: Colorado State University Library (1907).
Golden:
- Colorado School of Mines, Arthur Lakes Library (1939).
- Jefferson County Public Library, Bonfils-Stanton Regional Library (1968).

Greeley: University of Northern Colorado Library (1966).
Gunnison: Western State College, Leslie J. Savage Library (1932).
La Junta: Otero Junior College, Wheeler Library (1963).
Pueblo:
- Pueblo Regional Library (1893).
- Southern Colorado State College Library (1965).

U.S. Air Force Academy: Academy Library (1956).

## CONNECTICUT

Bridgeport: Bridgeport Public Library (1884).
Danbury: Western Connecticut State College, Ruth A. Haas Library (1967).
Enfield: Enfield Public Library (1967).

Hartford:
Connecticut State Library (unknown) – REGIONAL.
Hartford Public Library (1945).
Trinity College Library (1895).
Middletown: Wesleyan University Library (1906).
Mystic: Marine Historical Association, Inc., Mystic Seaport Library (1964).
New Britain: Central Connecticut State College, Elihu Burritt Library (1973).
New Haven:
Southern Connecticut State College Library (1968).
Yale University Library (1859).
New London:
Connecticut College Library (1926).
U.S. Coast Guard Academy Library (1939).
Pomfret: Pomfret School Library (1968).
Stamford: Stamford Public Library (1973).
Storrs: University of Connecticut, Wilbur Cross Library (1907).
Waterbury: Silas Bronson Library (1869).
West Haven: University of New Haven Library (1971).

## DELAWARE

Dover:
Delaware State College, William C. Jason Library (1962).
State Department of Community Affairs and Economic Development, Division of Libraries (1972).
State Law Library in Kent County (unknown).
Georgetown: Delaware Technical and Community College, Southern Branch Library (1968).
Newark: University of Delaware, Morris Library (1907).
Wilmington: Wilmington Institute and New Castle County Library (1861).

## DISTRICT OF COLUMBIA

Washington:
Advisory Commission on Intergovernmental Relations Library.
Civil Service Commission Library (1963).
Department of Commerce Library (1955).
Department of Health, Education, and Welfare Library (1954).
Department of Housing and Urban Development Library (1969).
Department of the Interior Central Library (1895).
Department of the Interior, Geological Survey Library (1962).
Department of Justice Main Library (1895).
Department of State Library (1895).
Department of State, Office of Legal Advisor, Law Library (1966).
Department of Transportation, National Highway Traffic Safety Administration Library (1968).
District of Columbia Public Library (1943).
District of Columbia Court of Appeals Library (1973).
Federal Bureau of Investigation Academy Library (1970).
Federal City College Library (1970).
Federal Deposit Insurance Corporation Library (1972).
Georgetown University Library (1969).
Indian Claims Commission Library (1968).
National Agricultural Library (1895).
National War College Library (1895).
Navy Department Library (1895).
Navy Department, Office of Judge Advocate General Library (1963).
Office of Management and Budget Library (1965).
Office of the Adjutant General, Department of Army Library (1969).
Postal Service Library (1895).
Treasury Department Library (1895).
Veterans Administration, Central Office Library (1967).

## FLORIDA

Boca Raton: Florida Atlantic University Library (1963).
Clearwater: Clearwater Public Library (1972).
Coral Gables: University of Miami Library (1939).
Daytona Beach: Volusia County Public Libraries (1963).
De Land: Stetson University, duPont-Ball Library (1887).
Fort Lauderdale:
Fort Lauderdale Public Library (1967).
Nova University Library (1967).
Gainesville: University of Florida Libraries (1907) – REGIONAL.
Jacksonville:
Haydon Burns Library (1914).
Jacksonville University, Swisher Library (1962).
University of North Florida Library (1972).
Lakeland: Lakeland Public Library (1 28).
Leesburg: Lake-Sumter Community College Library (1963).
Melbourne: Florida Institute of Technology Library (1963).
Miami:
Florida International University Library (1970).
Miami-Dade Junior College, North Campus Library (1967).
Miami Public Library (1952).
Opa Locka: Biscayne College Library (1966).
Orlando: Florida Technological University Library (1966).
Palatka: St. Johns River Junior College Library (1963).
Pensacola: University of West Florida, John C. Pace Library (1966).
St. Petersburg: St. Petersburg Public Library (1965).
Sarasota: Sarasota Public Library (1970).
Tallahassee:
Florida Agricultural and Mechanical University, Coleman Memorial Library (1936).
Florida State Library (1929).
Florida State University, R. M. Strozier Library (1941).
Tampa:
Tampa Public Library (1965).
University of South Florida Library (1962).
University of Tampa, Merle Kelce Library (1953).
Winter Park: Rollins College, Mills Memorial Library (1909).

## GEORGIA

Albany: Albany Public Library (1964).
Americus: Georgia Southwestern College, James Earl Carter Library (1966).
Athens: University of Georgia Libraries (1907).
Atlanta:
Atlanta Public Library (1880).
Atlanta University, Trevor Arnett Library (1962).
Emory University, Robert W. Woodruff Library (1928).
Emory University, School of Law Library (1968).
Georgia Institute of Technology, Prince Gilbert Memorial Library (1963).
Georgia State Library (unknown).
Georgia State University Library (1970).
Augusta: Augusta College Library (1962).
Brunswick: Brunswick Public Library (1965).
Carrollton: West Georgia College, Sanford Library (1962).
Dahlonega: North Georgia College Library (1939).

Gainesville: Chestatee Regional Library (1968).
Macon: Mercer University Library (1964).
Marietta: Kennesaw Junior College Library (1968).
Milledgeville: Georgia College at Milledgeville, Ina Dillard Russell Library (1950).
Mount Berry: Berry College, Memorial Library (1970).
Savannah: Savannah Public and Chatham-Effingham Liberty Regional Library (1857).
Statesboro: Georgia Southern College, Rosenwald Library (1939).
Valdosta: Valdosta State College, Richard Holmes Powell Library (1956).

## GUAM

Agana: Nieves M. Flores Memorial Library (1962).

## HAWAII

Hilo: University of Hawaii, Hilo Campus Library (1962).
Honolulu:
- Chaminade College of Honolulu Library (1965).
- Hawaii Medical Library, Inc. (1968).
- Hawaii State Library (1929).
- Municipal Reference Library of the City and County of Honolulu (1965).
- Supreme Court Law Library (1973).
- University of Hawaii Library (1907).

Laie: Church College of Hawaii Library (1964).
Lihue: Kauai Public Library (1967).
Pearl City: Leeward Community College Library (1967).
Wailuku: Maui Public Library (1962).

## IDAHO

Boise:
- Boise State College Library (1966).
- Boise Public Library (1929).
- Idaho State Law Library (unknown).
- Idaho State Library (1971).

Caldwell: College of Idaho, Terteling Library (1930).
Moscow: University of Idaho Library (1907)—REGIONAL.
Pocatello: Idaho State University Library (1908).
Rexburg: Ricks College, David O. McKay Library (1946).
Twin Falls: College of Southern Idaho Library (1970).

## ILLINOIS

Bloomington: Illinois Wesleyan University Libraries (1964).
Carbondale: Southern Illinois University Library (1932).
Carlinville: Blackburn College Library (1954).
Carterville: Shawnee Library System (1971).
Champaign: University of Illinois Law Library, College of Law (1965).
Charleston: Eastern Illinois University, Booth Library (1962).
Chicago:
- Field Museum of Natural History Library (1963).
- Chicago Public Library (1876).
- Chicago State University Library (1954).
- John Crerar Library (1909).
- Loyola University of Chicago, E. M. Cudahy Memorial Library (1966).
- Newberry Library (1890).
- Northeastern Illinois University Library (1961).
- University of Chicago Law Library (1964).
- University of Chicago Library (1897).
- University of Illinois, Chicago Circle Campus Library (1957).

Decatur: Decatur Public Library (1954).
De Kalb: Northern Illinois University, Swen Franklin Parson Library (1960).
Edwardsville: Southern Illinois University, Lovejoy Memorial Library (1959).
Elsah: Principia College, Marshall Brooks Library (1957).
Evanston: Northwestern University Library (1876).
Freeport: Freeport Public Library (1905).
Galesburg: Galesburg Public Library (1896).
Jacksonville: MacMurry College, Henry Pfeiffer Library (1929).
Kankakee: Olivet Nazarene College, Memorial Library (1946).
Lake Forest: Lake Forest College, Donnelley Library (1962).
Lebanon: McKendree College, Holman Library (1968).
Lisle: Illinois Benedictine College, Theodore F. Lownik Library (1911).
Lockport: Lewis College of Science and Technology Library (1952).
Macomb: Western Illinois University Memorial Library (1962).
Moline: Black Hawk College, Learning Resources Center (1970).
Monmouth: Monmouth College Library (1860).
Normal: Illinois State University, Milner Library (1877).
Oak Park: Oak Park Public Library (1963).
Palos Hills: Moraine Valley Community College Library (1972).
Peoria:
- Bradley University, Cullom Davis Library (1963).
- Peoria Public Library (1883).

River Forest: Rosary College Library (1966).
Rockford: Rockford Public Library (unknown).
Springfield: Illinois State Library (unknown)—REGIONAL.
Urbana: University of Illinois Library (1907).
Wheaton: Wheaton College Library (1964).
Woodstock: Woodstock Public Library (1963).

## INDIANA

Anderson: Anderson College, Charles E. Wilson Library (1959).
Bloomington: Indiana University Library (1881).
Crawfordsville: Wabash College, Lilly Library (1906).
Evansville:
- Evansville and Vanderburgh County Public Library (1928).
- Indiana State University, Evansville Campus Library (1969).

Fort Wayne:
- Indiana-Purdue Universities, Regional Campus Library (1965).
- Public Library of Fort Wayne and Allen County (1896).

Gary:
- Gary Public Library (1943).
- Indiana University, Northwest Campus Library (1966).

Greencastle: De Pauw University, Roy O. West Library (1879).
Hammond: Hammond Public Library (1964).
Hanover: Hanover College Library (1892).
Huntington: Huntington College Library (1964).
Indianapolis:
- Butler University, Irwin Library (1965).
- Indiana State Library (unknown)—REGIONAL.
- Indiana University, Law Library (1967).
- Indianapolis Public Library (1906).

Jeffersonville: Indiana University, Southeastern Campus Library (1965).
Kokomo: Indiana University, Kokomo Regional Campus Library (1969).
Lafayette: Purdue University Library (1907).

Muncie:
Ball State University Library (1959).
Muncie Public Library (1906).
Notre Dame: University of Notre Dame, Memorial Library (1883).
Rensselaer: St. Joseph's College Library (1964).
Richmond:
Earlham College, Lilly Library (1964).
Morrison-Reeves Library (1906).
South Bend: Indiana University at South Bend Library (1965).
Terre Haute: Indiana State University, Cunningham Memorial Library (1906).
Valparaiso: Valparaiso University, Moellering Memorial Library (1930).

## IOWA

Ames: Iowa State University of Science and Technology Library (1907).
Cedar Falls: University of Northern Iowa Library (1946).
Council Bluffs:
Free Public Library (1885).
Iowa Western Community College, Hoover Media Library (1972).
Des Moines:
Drake University, Cowles Library (1966).
Drake University Law Library (1972).
Iowa State Traveling Library (unknown).
Public Library of Des Moines (1888).
Dubuque:
Carnegie-Stout Public Library (unknown).
Loras College, Wahlert Memorial Library (1967).
Grinnell: Grinnell College, Burling Library (1874).
Iowa City:
University of Iowa, Law Library (1968).
University of Iowa Library (1884)—REGIONAL.
Lamoni: Graceland College, Frederick Madison Smith Library (1927).
Mount Vernon: Cornell College, Russell D. Cole Library (1896).
Orange City: Northwestern College, Ramaker Library (1970).
Sioux City: Sioux City Public Library (1894).

## KANSAS

Atchison: Benedictine College Library (1965).
Baldwin City: Baker University Library (1908).
Colby: Colby Community Junior College Library (1968).
Emporia: Kansas State Teachers College, William Allen White Library (1909).
Hays: Fort Hays Kansas State College, Forsyth Library (1926).
Hutchinson: Hutchinson Public Library (1963).
Lawrence:
University of Kansas, Watson Library (1869).
University of Kansas Law Library (1971).
Manhattan: Kansas State University, Farrell Library (1907).
Pittsburg: Kansas State College of Pittsburg, Porter Library (1952).
Salina: Kansas Wesleyan University, Memorial Library (1930).
Topeka:
Kansas State Historical Society Library (1877).
Kansas State Library (unknown).
Washburn University of Topeka, Law Library (1971).
Wichita: Wichita State University Library (1901).

## KENTUCKY

Ashland: Ashland Public Library (1946).
Barbourville: Union College, Abigail E. Weeks Memorial Library (1958).
Bowling Green: Western Kentucky University, Cravens Graduate Center and Library (1934).
Covington: Thomas More College Library (1970).
Danville: Centre College, Grace Doherty Library (1884).
Frankfort:
Kentucky Department of Libraries (1967).
Kentucky State University, Blazer Library (1972).
State Law Library (unknown).
Highland Heights: Northern Kentucky State College Library (1973).
Lexington:
University of Kentucky, Law Library (1968).
University of Kentucky, Margaret I. King Library (1907)—REGIONAL.
Louisville:
Louisville Free Public Library (1904).
University of Louisville, Belknap Campus Library (1925).
Morehead: Morehead State University, Johnson Camden Library (1955).
Murray: Murray State University Library (1924).
Owensboro: Kentucky Wesleyan College Library (1966).
Pikeville: Pikeville College Library (1947).
Richmond: Eastern Kentucky University, John Grant Crabbe Library (1966).

## LOUISIANA

Baton Rouge:
Louisiana State University Law Library (1929).
Louisiana State University Library (1907)—REGIONAL.
Southern University Library (1952).
Eunice: Louisiana State University at Eunice, LeDoux Library (1969).
Hammond: Southeastern Louisiana University, Sims Memorial Library (1966).
Lafayette: University of Southwestern Louisiana Library (1938).
Lake Charles: McNeese State University, Frazar Memorial Library (1941).
Monroe: Northeast Louisiana University, Sandel Library (1963).
Natchitoches: Northwestern State University, Watson Memorial Library (1887).
New Orleans:
Isaac Delgado College, Moss Technical Library (1968).
Law Library of Louisiana (unknown).
Louisiana State University in New Orleans Library (1963).
Loyola University Library (1942).
New Orleans Public Library (1883).
Southern University in New Orleans Library (1962).
Tulane University, Howard-Tilton Memorial Library (1942).
U.S. Court of Appeals, Fifth Circuit Library (1973).
Pineville: Louisiana College, Richard W. Norton Memorial Library (1969).
Ruston: Louisiana Technical University Library (1896)—REGIONAL.
Shreveport:
Louisiana State University at Shreveport Library (1967).
Shreve Memorial Library (1923).
Thibodaux: Francis T. Nicholls State University, Leonidas Polk Library (1962).



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## MAINE

Augusta:
- Maine Law and Legislative Reference Library (1973).
- Maine State Library (unknown).

Bangor: Bangor Public Library (1884).
Brunswick: Bowdoin College, Hawthorne-Longfellow Library (1884).
Castine: Maine Maritime Academy, Nutting Memorial Library (1969).
Lewiston: Bates College Library (1883).
Orono: University of Maine, Raymond H. Fogler Library (1907)—REGIONAL.
Portland:
- Portland Public Library (1884).
- University of Maine Law Library (1964).

Springvale: Nasson College Library (1961).
Waterville: Colby College Library (1884).

## MARYLAND

Annapolis:
- Maryland State Library (unknown).
- U.S. Naval Academy Library (1895).

Baltimore:
- Enoch Pratt Free Library (1887).
- Johns Hopkins University, Milton S. Eisenhower Library (1882).
- Morgan State College, Soper Library (1940).
- University of Baltimore, Langsdale Library (1973).
- University of Maryland, Baltimore County Library (1971).
- University of Maryland, School of Law Library (1969).

Bel Air: Harford Community College Library (1967).
Chestertown: Washington College, Chester M. Miller Library (1891).
College Park: University of Maryland, McKeldin Library (1925)—REGIONAL
Frostburg: Frostburg State College Library (1967).
Germantown: Atomic Energy Commission Library (1963).
Patuxent River: Naval Air Station Library (1968).
Rockville: Montgomery County Department of Public Libraries (1951).
Salisbury: Salisbury State College, Blackwell Library (1965).
Towson: Goucher College, Julia Rogers Library (1966).
Westminster: Western Maryland College Library (1896).

## MASSACHUSETTS

Amherst:
- Amherst College Library (1884).
- University of Massachusetts, Goodell Library (1907).

Belmont: Belmont Memorial Library (1968).
Boston:
- Boston Athenaeum Library (unknown).
- Boston College, Bapst Library (1963).
- Boston Public Library (1859)—REGIONAL.
- Northeastern University, Dodge Library (1962).
- State Library of Massachusetts (unknown).

Brookline: Public Library of Brookline (1925).
Cambridge:
- Harvard College Library (1860).
- Massachusetts Institute of Technology Libraries (1946).

Chicopee: Our Lady of the Elms College Library (1969).
Lowell: Lowell Technological Institute, Alumni Memorial Library (1952).
Lynn: Lynn Public Library (1953).
Marlborough: Marlborough Public Library (1971).
Medford: Tufts University Library (1899).
Milton: Curry College Library (1972).
New Bedford: New Bedford Free Public Library (1858).
North Dartmouth: Southeastern Massachusetts University Library (1965).
North Easton: Stonehill College, Cushing-Martin Library (1962).
Springfield: Springfield City Library (1966).
Waltham: Brandeis University, Goldfarb Library (1965).
Wellesley: Wellesley College Library (1943).
Wenham: Gordon College, Winn Library (1963).
Williamstown: Williams College Library (unknown).
Wilmington: Wilmington Memorial Library (1971).
Worcester:
- American Antiquarian Society Library (1814).
- University of Massachusetts, Medical Center Library (1972).
- Worcester Public Library (1859).

## MICHIGAN

Albion: Albion College, Stockwell Memorial Library (1966).
Allendale: Grand Valley State College Library (1963).
Alma: Alma College, Monteith Library (1963).
Ann Arbor:
- Great Lakes Basin Library (1971).
- University of Michigan, Harlan Hatcher Library (1884).

Benton Harbor: Benton Harbor Public Library (1907).
Bloomfield Hills: Cranbrook Institute of Science Library (1940).
Dearborn:
- Henry Ford Centennial Library (1969).
- Henry Ford Community College Library (1957).

Detroit:
- Detroit Public Library (1868)—REGIONAL.
- Marygrove College Library (1965).
- Mercy College of Detroit Library (1965).
- University of Detroit Library (1884).
- Wayne County Public Library (1957).
- Wayne State University Law Library (1971).
- Wayne State University, G. Flint Purdy Library (1937).

Dowagiac: Southwestern Michigan College Library (1971).
East Lansing:
- Michigan State University, Law Library (1971).
- Michigan State University Library (1907).

Escanaba: Michigan State Library, Upper Peninsula Branch (1964).
Farmington: Martin Luther King Learning Resources Center, Oakland Community College (1968).
Flint:
- Charles Stewart Mott Library (1959).
- Flint Public Library (1967).

Grand Rapids:
- Grand Rapids Public Library (1876).
- Calvin College Library (1967).

Houghton: Michigan Technological University Library (1876).
Jackson: Jackson Public Library (1965).
Kalamazoo:
- Kalamazoo Library System (1907).
- Western Michigan University, Dwight B. Waldo Library (1963).

Lansing: Michigan State Library (unknown)—REGIONAL.
Livonia: Schoolcraft College Library (1962).
Marquette: Northern Michigan University, Olsen Library (1963).
Mt. Clemens: Macomb County Library (1968).
Mt. Pleasant: Central Michigan University Library (1958).
Muskegon: Hackley Public Library (1894).
Petoskey: North Central Michigan College Library (1962).
Port Huron: Saint Clair County Library System (1876).
Rochester: Oakland University, Kresge Library (1964).
Saginaw: Hoyt Public Library (1890).

Traverse City: Northwestern Michigan College, Mark Osterlin Library (1964).
University Center: Delta College Library (1963).
Ypsilanti: Eastern Michigan University Library (1965).

## MINNESOTA

Bemidji: Bemidji State College, A. C. Clark Library (1963).
Collegeville: St. John's University, Alcuin Library (1954).
Duluth: Duluth Public Library (1909).
Mankato: Mankato State College Memorial Library (1962).
Minneapolis:
- Anoka County Library (1971).
- Southdale-Hennepin Area Library (1971).
- Minneapolis Public Library (1893).
- University of Minnesota, Wilson Library (1907)—REGIONAL.

Moorhead: Moorhead State College Library (1956).
Morris: University of Minnesota at Morris Library (1963).
Northfield:
- Carleton College Library (1930).
- St. Olaf College, Rolvaag Memorial Library (1930).

St. Cloud: St. Cloud State College Library (1962).
St. Paul:
- Minnesota Historical Society Library (1867).
- Minnesota State Law Library (unknown).
- St. Paul Public Library (1914).

Saint Peter: Gustavus Adolphus College Library (1941).
Stillwater: Stillwater Public Library (1893).
Willmar: Crow River Regional Library (1958).
Winona: Winona State College, Maxwell Library (1969).

## MISSISSIPPI

Columbus: Mississippi State College for Women, J. C. Fant Memorial Library (1929).
Hattiesburg: University of Southern Mississippi Library (1935).
Jackson:
- Jackson State College Library (1968).
- Millsaps College, Millsaps-Wilson Library (1963).
- Mississippi Library Commission (1947).
- Mississippi State Law Library (unknown).

Lorman: Alcorn Agricultural and Mechanical College Library (1970).
State College: Mississippi State University, Mitchell Memorial Library (1907).
University:
- University of Mississippi Library (1883).
- University of Mississippi, School of Law Library (1967).

## MISSOURI

Cape Girardeau: Southeast Missouri State College, Kent Library (1916).
Columbia: University of Missouri Library (1862).
Fayette: Central Methodist College Library (1962).
Fulton: Westminster College, Reeves Library (1875).
Jefferson City:
- Lincoln University, Inman E. Page Library (1944).
- Missouri State Library (1963).
- Missouri Supreme Court Library (unknown).

Joplin: Missouri Southern State College Library (1966).
Kansas City:
- Kansas City Public Library (1881).
- Rockhurst College Library (1917).
- University of Missouri at Kansas City, General Library (1938).

Kirksville: Northeast Missouri State Teachers College, Pickler Memorial Library (1966).
Liberty: William Jewell College Library (1900).
Rolla: University of Missouri at Rolla Library (1907).
St. Charles: Lindenwood College, Margaret Leggat Butler Library (1973).
St. Joseph: St. Joseph Public Library (1891).
St. Louis:
- St. Louis County Library (1970).
- St. Louis Public Library (1866).
- St. Louis University, Law Library (1967).
- St. Louis University, Pius XII Memorial Library (1866).
- University of Missouri at St. Louis, Thomas Jefferson Library (1966).
- U.S. Court of Appeals, Eighth Circuit Library (1972).
- Washington University, John M. Olin Library (1906).

Springfield:
- Drury College, Walker Library (1874).
- Southwest Missouri State College Library (1963).

Warrensburg: Central Missouri State College, Ward Edwards Library (1914).

## MONTANA

Billings: Eastern Montana College Library (1924).
Bozeman: Montana State University Library (1907).
Butte: Montana College of Mineral Science and Technology Library (1901).
Helena:
- Montana Historical Society Library (unknown).
- Montana State Library (1966).

Missoula: University of Montana Library (1909)—REGIONAL.

## NEBRASKA

Blair: Dana College, Dana-LIFE Library (1924).
Crete: Doane College, Whitin Library (1944).
Fremont: Midland Lutheran College Library (1924).
Kearney: Kearney State College, Calvin T. Ryan Library (1962).
Lincoln:
- Nebraska Publications Clearinghouse, Nebraska Library Commission (1972).
- Nebraska State Library (unknown).
- University of Nebraska, Don L. Love Memorial Library (1907).

Omaha:
- Creighton University, Alumni Library (1964).
- Omaha Public Library (1880).
- University of Nebraska at Omaha, Gene Eppley Library (1939).

Scottsbluff: Scottsbluff Public Library (1925).
Wayne: Wayne State College, U.S. Conn Library (1970).

## NEVADA

Carson City:
- Nevada State Library (unknown).
- Nevada Supreme Court Library.

Las Vegas: University of Nevada at Las Vegas, James R. Dickinson Library (1959).
Reno: University of Nevada Library (1907)—REGIONAL

## NEW HAMPSHIRE

Concord: New Hampshire State Library (unknown).
Durham: University of New Hampshire Library (1907).
Franconia: Franconia College Library (1972).
Hanover: Dartmouth College, Baker Library (1884).
Henniker: New England College Library (1966).
Manchester:
- Manchester City Library (1884).
- St. Anselm's College, Geisel Library (1963).

Nashua: Nashua Public Library (1971).

## NEW JERSEY

Bayonne: Bayonne Free Public Library (1909).
Bloomfield: Free Public Library of Bloomfield (1965).
Bridgeton: Cumberland County Library (1966).
Camden: Rutgers University-Camden Library (1966).
Convent Station: College of St. Elizabeth, Mahoney Library (1938).
East Orange: East Orange Public Library (1966).
Elizabeth: Free Public Library of Elizabeth (1895).
Glassboro: Glassboro State College, Savitz Learning Resource Center (1963).
Hackensack: Johnson Free Public Library (1966).
Irvington: Free Public Library of Irvington (1966).
Jersey City:
- Free Public Library of Jersey City (1879).
- Jersey City State College, Forrest A. Irwin Library (1963).

Madison: Drew University, Rose Memorial Library (1939).
Mahwah: Ramapo College Library (1971).
Mount Holly: Burlington County Library (1966).
New Brunswick:
- Free Public Library (1908).
- Rutgers University Library (1907).

Newark:
- Newark Public Library (1906)—REGIONAL.
- Rutgers-The State University, John Cotton Dana Library (1966).

Passaic: Passaic Public Library (1964).
Plainfield: Plainfield Public Library (1971).
Pomona: Stockton State College Library (1972).
Princeton: Princeton University Library (1884).
Rutherford: Fairleigh Dickinson University, Messler Library (1953).
Shrewsbury: Monmouth County Library (1968).
South Orange: Seton Hall University Library (1947).
Teaneck: Fairleigh Dickinson University, Teaneck Campus Library (1963).
Toms River: Ocean County College Learning Resources Center (1966).
Trenton:
- New Jersey State Library, Law and Reference Bureau, Department of Education (unknown).
- Trenton Free Public Library (1902).

Union: Newark State College, Nancy Thompson Library (1973).
Upper Montclair: Montclair State College, Harry A. Sprague Library (1967).
Wayne: Wayne Public Library (1972).
West Long Branch: Monmouth College, Guggenheim Memorial Library (1963).
Woodbridge: Free Public Library of Woodbridge (1965).

## NEW MEXICO

Albuquerque: University of New Mexico, Zimmerman Library (1896)—REGIONAL.
Hobbs: New Mexico Junior College, Pannell Library (1969).
Las Cruces: New Mexico State University Library (1907).
Las Vegas: New Mexico Highlands University, Donnelly Library (1913).
Portales: Eastern New Mexico University Library (1962).
Santa Fe:
- New Mexico State Library (1960)—REGIONAL.
- Supreme Court Law Library (unknown).

Silver City: Western New Mexico University, Miller Library (1972).

## NEW YORK

Albany:
- New York State Library (unknown)—REGIONAL.
- State University of New York at Albany Library (1964).

Auburn: Seymour Library (1972).
Bayside: Queensborough Community College Library (1972).
Binghamton: State University of New York at Binghamton Library (1962).
Brockport: State University of New York, Drake Memorial Library (1967).
Bronx:
- Herbert H. Lehman College Library (1967).
- New York Public Library, Mott Haven Branch (1973).

Bronxville: Sarah Lawrence College Library (1969).
Brooklyn:
- Brooklyn College Library (1936).
- Brooklyn Public Library (1908).
- Polytechnic Institute of Brooklyn, Spicer Library (1963).
- Pratt Institute Library (1891).
- State University of New York, Downstate Medical Center Library (1958).

Buffalo:
- Buffalo and Erie County Public Library (1895).
- State University of New York at Buffalo, Lockwood Memorial Library (1963).

Canton: St. Lawrence University, Owen D. Young Library (1920).
Corning: Corning Community College, Arthur A. Houghton, Jr. Library (1963).
Cortland: State University of New York, College at Cortland, Memorial Library (1964).
Delhi: State University Agricultural and Technical College Library (1970).
Douglaston: Cathedral College Library (1971).
Elmira: Elmira College, Gannett-Tripp Learning Center (1956).
Farmingdale: State University Agricultural and Technical Institute at Farmingdale Library (1917).
Flushing: Queens College, Paul Klapper Library (1939).
Garden City:
- Adelphi University, Swirbul Library (1966).
- Nassau Library System (1965).

Geneseo: State University College, Milne Library (1967).
Greenvale: C. W. Post College, B. Davis Schwartz Memorial Library (1964).
Hamilton: Colgate University Library (1902).
Hempstead: Hofstra University Library (1964).
Huntington: Huntington Public Library (1966).
Ithaca:
- Cornell University Library (1907).
- New York State Colleges of Agriculture and Home Economics, Albert R. Mann Library (1943).

Jamaica:
- Queens Borough Public Library (1926).
- St. John's University Library (1956).

Kings Point: U.S. Merchant Marine Academy Library (1962).
Mount Vernon: Mount Vernon Public Library (1962).

New Paltz: State University College Library (1965).
New York City:
City University of New York, City College Library (1884).
College of Insurance, Ecker Library (1965).
Columbia University Libraries (1882).
Cooper Union Library (1930).
Fordham University Library (1937).
New York Law Institute Library (1909).
New York Public Library (Astor Branch) (1907).
New York Public Library (Lenox Branch) (1884).
New York University Libraries (1967).
New York University, University Heights Gould Memorial Library (1902).
State University of New York, Maritime College Library (1947).
Newburgh: Newburgh Free Library (1909).
Oakdale: Dowling College Library (1965).
Oneonta: State University College, James M. Milne Library (1966).
Oswego: State University College, Penfield Library (1966).
Plattsburgh: State University College, Benjamin F. Feinberg Library (1967).
Potsdam:
Clarkson College of Technology, Harriet Call Burnap Memorial Library (1938).
State University College, Frederick W. Crumb Memorial Library (1964).
Poughkeepsie: Vassar College Library (1943).
Purchase: State University of New York, College at Purchase Library (1969).
Rochester:
Rochester Public Library (1963).
University of Rochester Library (1880).
St. Bonaventure: St. Bonaventure College, Friedsam Memorial Library (1938).
Saratoga Springs: Skidmore College Library (1964).
Schenectady: Union College, Schaffer Library (1901).
Southampton: Southampton College Library (1973).
Staten Island (Grymes Hill): Wagner College, Horrmann Library (1953).
Stony Brook: State University of New York at Stony Brook Library (1963).
Syracuse: Syracuse University Library (1878).
Troy: Troy Public Library (1869).
Utica: Utica Public Library (1885).
West Point: U.S. Military Academy Library (unknown).
Yonkers: Yonkers Public Library (1910).

## NORTH CAROLINA

Asheville: University of North Carolina at Asheville, D. Hiden Ramsey Library (1965).
Boone: Appalachian State University Library (1963).
Buies Creek: Campbell College, Carrie Rich Memorial Library (1965).
Chapel Hill: University of North Carolina Library (1884)—REGIONAL.
Charlotte:
Public Library of Charlotte and Mecklenburg County (1964).
Queens College, Everett Library (1927).
University of North Carolina at Charlotte, Atkins Library (1964).
Cullowhee: Western Carolina University, Hunter Library (1953).
Davidson: Davidson College, Hugh A. & Jane Grey Memorial Library (1893).
Durham:
Duke University, William R. Perkins Library (1890).
North Carolina Central University, James E. Shepard Memorial Library (1973).
Elon College: Elon College Library (1971).
Fayetteville: Fayetteville State University, Chestnutt Library (1971).
Greensboro:
North Carolina Agricultural and Technical State University, F. D. Bluford Library (1937).
University of North Carolina at Greensboro, Walter Clinton Jackson Library (1963).
Greenville: East Carolina University, J. Y. Joyner Library (1951).
Laurinburg: St. Andrews Presbyterian College, DeTamble Library (1969).
Lexington: Davidson County Public Library System (1971).
Mount Olive: Mount Olive College, Moye Library (1971).
Murfreesboro: Chowan College, Whitaker Library (1963).
Pembroke: Pembroke State University Library (1965).
Raleigh:
North Carolina State Library (unknown).
North Carolina State University, D. H. Hill Library (1923).
North Carolina Supreme Court Library (1972).
Wake County Public Libraries (1969).
Rocky Mount: North Carolina Wesleyan College Library (1969).
Salisbury: Catawba College Library (1925).
Wilmington: University of North Carolina at Wilmington, William M. Randall Library (1965).
Wilson: Atlantic Christian College, Clarence L. Hardy Library (1930).
Winston-Salem:
Forsyth County Public Library System (1954).
Wake Forest University, Z. Smith Reynolds Library (1902).

## NORTH DAKOTA

Bismarck:
State Historical Society of North Dakota (1907).
North Dakota State Law Library (unknown).
State Library Commission Library (1971).
Veterans Memorial Public Library (1967).
Dickinson: Dickinson State College Library (1968).
Fargo:
Fargo Public Library (1964).
North Dakota State University Library (1907)—REGIONAL, in cooperation with University of North Dakota, Chester Fritz Library at Grand Forks.
Grand Forks: University of North Dakota, Chester Fritz Library (1890).
Minot: Minot State College, Memorial Library (1925).
Valley City: State College Library (1913).

## OHIO

Ada: Ohio Northern University, J. P. Taggart Law Library (1965).
Akron:
Akron Public Library (1952).
University of Akron Library (1963).
Alliance: Mount Union College Library (1888).
Ashland: Ashland College Library (1938).
Athens: Ohio University Library (1886).
Bluffton: Bluffton College, Musselman Library (1951).
Bowling Green: Bowling Green State University Library (1933).
Canton: Malone College, Everett L. Cattell Library (1970).
Chardon: Geauga County Public Library (1971).

Cincinnati:
Public Library of Cincinnati and Hamilton County (1884).
University of Cincinnati Library (1929).
Cleveland:
Case Western Reserve University, Freiberger Library (1913).
Cleveland Heights-University Heights Public Library (1970).
Cleveland Public Library (1886).
Cleveland State University Library (1966).
John Carroll University, Grasselli Library (1963).
Municipal Reference Library (1970).
Columbus:
Capital University Library (1968).
Columbus Public Library (1885).
Ohio State Library (unknown)—REGIONAL.
Ohio State University Library (1907).
Ohio Supreme Court Law Library (1973).
Dayton:
Dayton and Montgomery County Public Library (1909).
University of Dayton, Albert Emanuel Library (1969).
Wright State University Library (1965).
Delaware: Ohio Wesleyan University, L. A. Beeghly Library (1845).
Elyria: Elyria Public Library (1966).
Findlay: Findlay College, Shafer Library (1969).
Gambier: Kenyon College Library (1873).
Granville: Denison University Library (1884).
Hiram: Hiram College, Teachout-Price Memorial Library (1874).
Kent: Kent State University Library (1962).
Marietta: Marietta College, Dawes Memorial Library (1884).
Middletown: Miami University at Middletown, Gardner-Harvey Library (1970).
New Concord: Muskingum College Library (1966).
Oberlin: Oberlin College Library (1858).
Oxford: Miami University, Alumni Library (1909).
Portsmouth: Portsmouth Public Library (unknown).
Rio Grande: Rio Grande College, Jeanette Albiez Davis Library (1966).
Springfield: Warder Public Library (1884).
Steubenville:
College of Steubenville, Starvaggi Memorial Library (1971).
Public Library of Steubenville and Jefferson County (1950).
Tiffin: Heidelberg College, Beeghly Library (1964).
Toledo:
Toledo-Lucas County Public Library (1884).
University of Toledo Library (1963).
Westerville: Otterbein College, Centennial Library (1967).
Wooster: College of Wooster, The Andrews Library (1966).
Youngstown:
Public Library of Youngstown and Mahoning County (1923).
Youngstown State University Library (1971).

## OKLAHOMA

Ada: East Central State College, Linscheid Library (1914).
Alva: Northwestern State College Library (1907).
Bartlesville: Bureau of Mines, Petroleum Research Center Library (1962).
Bethany: Bethany Nazarene College, R. T. Williams Library (1971).
Durant: Southeastern State College Library (1929).
Edmond: Central State University Library (1934).
Enid: Public Library of Enid and Garfield County (1908).
Langston: Langston University, G. Lamar Harrison Library (1941).
Muskogee: Muskogee Public Library (1971).
Norman: University of Oklahoma Libraries (1893).
Oklahoma City:
Oklahoma City University Library (1963).
Oklahoma Department of Libraries (1893)—REGIONAL.
Shawnee: Oklahoma Baptist University Library (1933).
Stillwater: Oklahoma State University Library (1907).
Tahlequah: Northeastern State College, John Vaughan Library (1923).
Tulsa:
Tulsa City-County Library Commission (1963).
University of Tulsa, McFarlin Library (1929).
Weatherford: Southwestern State College Library (1958).

## OREGON

Ashland: Southern Oregon College Library (1953).
Corvallis: Oregon State University Library (1907).
Eugene: University of Oregon Library (1883).
Forest Grove: Pacific University Library (1897).
La Grande: Eastern Oregon College, Walter M. Pierce Library (1954).
McMinnville: Linfield College, Northup Library (1965).
Monmouth: Oregon College of Education Library (1967).
Portland:
Department of the Interior, Bonneville Power Administration Library (1962).
Lewis and Clark College, Aubrey R. Watzek Library (1967).
Library Association of Portland (1884).
Portland State University Library (1963)—REGIONAL.
Reed College Library (1912).
Salem:
Oregon State Library (unknown).
Williamette University Library (1969).

## PENNSYLVANIA

Allentown: Muhlenberg College, Haas Library (1939).
Altoona: Altoona Public Library (1969).
Bethlehem: Lehigh University, Linderman Library (1876).
Carlisle: Dickinson College, Boyd Lee Spahr Library (1947).
Cheyney: Cheyney State College, Leslie Pinckney Hill Library (1947).
Collegeville: Ursinus College, Myrin Library (1963).
Doylestown: Bucks County Free Library, Center County Library (1970).
East Stroudsburg: East Stroudsburg State College, Kemp Library (1966).
Erie: Erie Public Library (1897).
Greenville: Thiel College, Langenheim Memorial Library (1963).
Harrisburg: State Library of Pennsylvania (unknown)—REGIONAL.
Haverford: Haverford College Library (1897).
Hazleton: Hazleton Area Public Library (1964).
Indiana: Indiana University of Pennsylvania, Rhodes R. Stabley Library (1962).
Johnstown: Cambria Public Library (1965).
Lancaster: Franklin and Marshall College, Fackenthal Library (1895).
Lewisburg: Bucknell University, Ellen Clarke Bertrand Library (1963).
Mansfield: Mansfield State College Library (1968).
Meadville: Allegheny College, Reis Library (1907).
Millersville: Millersville State College, Ganser Library (1966).
Monessen: Monessen Public Library (1969).

New Castle: New Castle Free Public Library (1963).
Newtown: Bucks County Community College Library (1968).
Norristown: Montgomery County-Norristown Public Library (1969).
Philadelphia:
- Drexel University Library (1963).
- Free Library of Philadelphia (1897).
- Temple University, Samuel Paley Library (1947).
- University of Pennsylvania Library (1886).

Pittsburgh:
- Bureau of Mines, Pittsburgh Research Center Library (1962).
- Carnegie Library of Pittsburgh, Allegheny Regional Branch (1924).
- Carnegie Library of Pittsburgh (1895).
- University of Pittsburgh, Hillman Library (1910).

Pottsville: Pottsville Free Public Library (1967).
Reading: Reading Public Library (1901).
Scranton: Scranton Public Library (1895).
Shippensburg: Shippensburg State College, Ezra Lehman Memorial Library (1973).
Slippery Rock: Slippery Rock State College, Maltby Library (1965).
Swarthmore: Swarthmore College Library (1923).
University Park: Pennsylvania State University Library (1907).
Villanova: Villanova University, School of Law Library (1964).
Warren: Warren Library Association, Warren Public Library (1885).
Washington: Washington and Jefferson College, Memorial Library (1884).
Waynesburg: Waynesburg College Library (1964).
West Chester: West Chester State College, Francis Harvey Green Library (1967).
Wilkes-Barre: King's College, Corgan Library (1949).
Williamsport: Lycoming College Library (1970).
York: York Junior College Library (1963).
Youngwood: Westmoreland County Community College, Learning Resource Center (1972).

## PUERTO RICO

Mayaguez: University of Puerto Rico, Mayaguez Campus Library (1928).
Ponce: Catholic University of Puerto Rico Library (1966).
Rio Piedras: University of Puerto Rico General Library (1928).

## RHODE ISLAND

Kingston: University of Rhode Island Library (1907).
Newport: Naval War College Library (1963).
Providence:
- Brown University, John D. Rockefeller, Jr. Library (unknown).
- Providence College, Phillips Memorial Library (1969).
- Providence Public Library (1884).
- Rhode Island College Library (1965).
- Rhode Island State Library (before 1895).

Warwick: Warwick Public Library (1966).
Westerly: Westerly Public Library (1909).

## SOUTH CAROLINA

Charleston:
- Baptist College at Charleston Library (1967).
- College of Charleston Library (1869).
- The Citadel Memorial Library (1962).

Clemson: Clemson University Library (1893).
Columbia:
- Benedict College, Starks Library (1969).
- Columbia College Library (1966).
- South Carolina State Library (before 1895).
- South Carolina Supreme Court Library (1972).
- University of South Carolina Undergraduate Library (1884).

Due West: Erskine College, McCain Library (1968).
Florence:
- Florence County Library (1967).
- Francis Marion College, James A. Rogers Library (1970).

Greenville:
- Furman University Library (1962).
- Greenville County Library (1966).

Greenwood: Lander College Library (1967).
Orangeburg: South Carolina State College, Whittaker Library (1953).
Rock Hill: Winthrop College Library (1896).
Spartanburg: Spartanburg County Public Library (1967).

## SOUTH DAKOTA

Aberdeen: Northern State College Library (1963).
Brookings: South Dakota State University, Lincoln Memorial Library (1889).
Rapid City:
- Rapid City Public Library (1963).
- South Dakota School of Mines and Technology Library (1963).

Sioux Falls:
- Augustana College, Mikkelsen Library and Learning Resources Center (1969).
- Sioux Falls Public Library (1903).

Spearfish: Black Hills State College Library (1942).
Vermillion: University of South Dakota, I. D. Weeks Library (1889).
Yankton: Yankton College, Corliss Lay Library (1904).

## TENNESSEE

Bristol: King College Library (1970).
Chattanooga: Chattanooga Public Library (1907).
Clarksville: Austin Peay State University, Felix G. Woodward Library (1945).
Cookeville: Tennessee Technological University, Jere Whitson Memorial Library (1969).
Jackson: Lambuth College, Luther L. Gobbel Library (1967).
Jefferson City: Carson-Newman College Library (1964).
Johnson City: East Tennessee State University, Sherrod Library (1942).
Knoxville:
- Public Library of Knoxville and Knox County, Lawson McGhee Library (1973).
- University of Tennessee Law Library (1971).
- University of Tennessee Library (1907).

Martin: University of Tennessee at Martin Library (1957).
Memphis:
- Memphis Public Library and Information Center (1896).
- Memphis State University, John W. Brister Library (1966).

Morristown: Morristown College, Carnegie Library (1970).
Murfreesboro: Middle Tennessee State University, Andrew L. Todd Library (1912).
Nashville:
- Fisk University Library (1965).
- Joint University Libraries (1884).
- Public Library of Nashville and Davidson County (1884).

Tennessee State Library and Archives, State Library Division (unknown).
Tennessee State University, Martha M. Brown Memorial Library (1972).
Sewanee: University of the South, Jesse Ball duPont Library (1873).

## TEXAS

Abilene: Hardin-Simmons University Library (1940).
Arlington:
Arlington Public Library (1970).
University of Texas at Arlington Library (1963).
Austin:
Texas State Law Library (1972).
Texas State Library (unknown)—REGIONAL.
University of Texas at Austin Library (1884).
University of Texas, Lyndon B. Johnson School of Public Affairs Library (1966).
University of Texas, School of Law Library (1965).
Baytown: Lee College Library (1970).
Beaumont: Lamar University Library (1957).
Brownwood: Howard Payne College, Walker Memorial Library (1964).
Canyon: West Texas State University Library (1928).
College Station: Texas Agricultural and Mechanical University Library (1907).
Commerce: East Texas State University Library (1937).
Corsicana: Navarro Junior College Library (1965).
Dallas:
Bishop College, Zale Library (1966).
Dallas Baptist College Library (1967).
Dallas Public Library (1900).
Southern Methodist University, Fondren Library (1925).
University of Texas at Dallas Library (1972).
Denton: North Texas State University Library (1948).
Edinburg: Pan American University Library (1959).
El Paso:
El Paso Public Library (1906).
University of Texas at El Paso Library (1966).
Fort Worth:
Fort Worth Public Library (1905).
Texas Christian University, Mary Couts Burnett Library (1916).
Galveston: Rosenberg Library (1909).
Houston:
Houston Public Library (1884).
Rice University, Fondren Library (1967).
University of Houston Library (1957).
Huntsville: Sam Houston State University, Estill Library (1949).
Kingsville: Texas Arts and Industries University Library (1944).
Lake Jackson: Brazosport College Library (1969).
Laredo: Laredo Junior College Library (1970).
Longview: Nicholson Memorial Public Library (1961).
Lubbock: Texas Tech University Library (1935)—REGIONAL.
Marshall: Wiley College, Cole Library (1962).
Nacogdoches: Stephen F. Austin State University Library (1965).
Plainview: Wayland Baptist College, Van Howeling Memorial Library (1963).
San Angelo: Angelo State University, Porter Henderson Library (1964).
San Antonio:
San Antonio College Library (1972).
San Antonio Public Library, Business and Science Department (1899).
St. Mary's University Library (1964).
Trinity University Library (1964).
San Marcos: Southwest Texas State University Library (1955).
Seguin: Texas Lutheran College, Blumberg Memorial Library (1970).
Sherman: Austin College, Arthur Hopkins Library (1963).
Texarkana: Texarkana Community College, Palmer Memorial Library (1963).
Waco: Baylor University Library (1905).
Wichita Falls: Midwestern University, Moffett Library (1963).

## UTAH

Cedar City: Southern Utah State College Library (1964).
Ephraim: Snow College, Lucy A. Phillips Library (1963).
Logan: Utah State University, Merrill Library and Learning Resources Center (1907)—REGIONAL.
Ogden: Weber State College Library (1962).
Provo:
Brigham Young University Library (1908).
Brigham Young University Law Library (1972).
Salt Lake City:
University of Utah, Law Library (1966).
University of Utah, Eccles Medical Sciences Library (1970).
University of Utah, Marriott Library (1893).
Utah State Library Commission, Documents Library (unknown).

## VERMONT

Burlington: University of Vermont, Bailey Library (1907).
Castleton: Castleton State College, Calvin Coolidge Library (1969).
Johnson: Johnson State College, John Dewey Library (1955).
Lyndonville: Lyndon State College, Samuel Reed Hall Library (1969).
Middlebury: Middlebury College, Egbert Starr Library (1884).
Montpelier: Vermont Department of Libraries (before 1895).
Northfield: Norwich University Library (1908).
Putney: Windham College, Dorothy Culbertson Marvin Memorial Library (1965).

## VIRGIN ISLANDS

Charlotte Amalie (St. Thomas):
College of the Virgin Islands, Ralph M. Paiewonsky Library (1973).
St. Thomas Public Library (1968).

## VIRGINIA

Blacksburg: Virginia Polytechnic Institute, Newman Library (1907).
Bridgewater: Bridgewater College, Alexander Mack Memorial Library (1902).
Charlottesville:
University of Virginia, Alderman Library (1910)—REGIONAL.
University of Virginia Law Library (1964).
Chesapeake: Chesapeake Public Library System (1970).
Danville: Danville Community College Library (1969).
Emory: Emory and Henry College Library (1884).

Fairfax: George Mason College of the University of Virginia, Fenwick Library (1960).
Fredericksburg: Mary Washington College, E. Lee Trinkle Library (1940).
Hampden-Sydney: Hampden-Sydney College, Eggleston Library (1891).
Harrisonburg: Madison College, Madison Memorial Library (1973).
Hollins College: Hollins College, Fishburn Library (1967).
Lexington:
Virginia Military Institute, Preston Library (1874).
Washington and Lee University, Cyrus Hall McCormick Library (1910).
Martinsville: Patrick Henry Community College Library (1971).
Norfolk:
Armed Forces Staff College Library (1963).
Norfolk Public Library (1895).
Old Dominion University, Hughes Memorial Library (1963).
Petersburg: Virginia State College, Johnston Memorial Library (1907).
Quantico: Marine Corps Schools, James Carson Breckinridge Library (1967).
Richmond:
State Law Library (1973).
University of Richmond, Boatwright Memorial Library (1900).
U.S. Court of Appeals, Fourth Circuit Library (1973).
Virginia Commonwealth University, James Branch Cabell Library (1971).
Virginia State Library (unknown).
Roanoke: Roanoke Public Library (1964).
Salem: Roanoke College Library (1886).
Williamsburg: William and Mary College Library (1936).
Wise: Clinch Valley College, John Cook Wyllie Library (1971).

## WASHINGTON

Bellingham: Western Washington State College, Wilson Library (1963).
Cheney: Eastern Washington State College Library (1966).
Ellensburg: Central Washington State College Library (1962).
Everett: Everett Public Library (1914).
Olympia:
Evergeen State College Library (1972).
Washington State Library (unknown)—REGIONAL.
Port Angeles: Port Angeles Public Library (1965).
Pullman: Washington State University Library (1907).
Seattle:
Seattle Public Library (1908).
University of Washington Library (1890).
University of Washington, School of Law Library (1969).
Spokane: Spokane Public Library (1910).
Tacoma:
Tacoma Public Library (1894).
University of Puget Sound, Collins Memorial Library (1938).
Vancouver: Fort Vancouver Regional Library (1962).
Walla Walla: Whitman College, Penrose Memorial Library (1890).

## WEST VIRGINIA

Athens: Concord College Library (1924).
Bluefield: Bluefield State College Library (1972).
Charleston:
Kanawha County Public Library (1952).
West Virginia Department of Archives and History Library (unknown).
Elkins: Davis and Elkins College Library (1913).
Fairmont: Fairmont State College Library (1884).
Glenville: Glenville State College, Robert F. Kidd Library (1966).
Huntington: Marshall University Library (1925).
Institute: West Virginia State College Library (1907).
Morgantown: West Virginia University Library (1907)—REGIONAL.
Salem: Salem College Library (1921).
Shepherdstown: Shepherd College Library (1971).
Weirton: Mary H. Weir Public Library (1963).

## WISCONSIN

Appleton: Lawrence University, Samuel Appleton Library (1869).
Beloit: Beloit College Libraries (1888).
Eau Claire: University of Wisconsin, Eau Claire, William D. McIntyre Library (1951).
Fond du Lac: Fond du Lac Public Library (1966).
Green Bay: University of Wisconsin at Green Bay Library (1968).
La Crosse:
La Crosse Public Library (1883).
University of Wisconsin-La Crosse, Murphy Library (1965).
Madison:
Department of Public Instruction, Division for Library Services, Reference and Loan Library (1965).
Madison Public Library (1965).
State Historical Society Library (1870)—REGIONAL, in cooperation with University of Wisconsin, Memorial Library.
University of Wisconsin, Memorial Library (1939).
Wisconsin State Library (unknown).
Milwaukee:
Alverno College Library (1971).
Milwaukee County Law Library (1934).
Milwaukee Public Library (1961)—REGIONAL.
Mount Mary College Library (1964).
Oklahoma Neighborhood Library (1965).
University of Wisconsin-Milwaukee Library (1960).
Oshkosh: University of Wisconsin-Oshkosh, Forrest R. Polk Library (1956).
Platteville: University of Wisconsin-Platteville, Elton S. Karrmann Library (1964).
Racine: Racine Public Library (1898).
River Falls: University of Wisconsin-River Falls, Chalmer Davee Library (1962).
Stevens Point: University of Wisconsin-Stevens Point, Learning Resources Center (1951).
Superior:
Superior Public Library (1908).
University of Wisconsin-Superior, Jim Dan Hill Library (1935).
Waukesha: Waukesha Public Library (1966).
Wausau: Wausau Public Library (1971).
Whitewater: Wisconsin State University, Harold Andersen Library (1963).

## WYOMING

Casper: Natrona County Public Library (1929).
Cheyenne: Wyoming State Library (unknown).
Laramie: University of Wyoming, Coe Library (1907).

Powell: Northwest Community College Library (1967).
Riverton: Central Wyoming College Library (1969).
Rock Springs: Western Wyoming College Library (1969).
Sheridan: Sheridan College, Mary Brown Kooi Library (1963).

# APPENDIX B. LIST OF FIELD OFFICES OF THE U.S. DEPARTMENT OF COMMERCE

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Area Code 617 Tel. 223-2312

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111 West Huron Street
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Area Code 803 Tel. 577-4361

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Area Code 312 Tel. 353-4450

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Area Code 313 Tel. 226-6063

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Area Code 305 Tel. 350-5267

MILWAUKEE, WISCONSIN 53203
Straus Building
238 West Wisconsin Avenue
Area Code 414 Tel. 224-3473

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306 Federal Building
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Area Code 212 Tel. 264-0600

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Jefferson Building
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Area Code 215 Tel. 597-2850

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Area Code 602 Tel. 261-3285

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Area Code 503 Tel. 221-3001

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2028 Federal Building
300 Booth Street
Area Code 702 Tel. 784-5203

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8010 Federal Building
400 North 8th Street
Area Code 703 Tel. 782-2246

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2511 Federal Building
1520 Market Street
Area Code 314 Tel. 622-4241

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Area Code 801 Tel. 524-5116

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450 Golden Gate Avenue
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Room 100, Post Office Building
Phone: 723-4640

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This supplement to Special Publication 305 Supplements 1, 2, 3, and 4 of the National Bureau of Standards lists the publications of the Bureau issued between January 1, 1973 and December 31, 1973. It includes an abstract of each publication (plus some earlier papers omitted from Special Publication 305 Supplement 3), key-word and author indexes; and general information and instructions about NBS publications.

Miscellaneous Publication 240 (covering the period July 1, 1957 through June 30, 1960) and its supplement (covering the period July 1, 1960 through June 30, 1966), Special Publication 305 (covering the period July 1966 through December 1967) and Special Publication 305 Supplement 1 (covering the period 1968-1969), Special Publication 305 Supplement 2 (covering the period 1970), Special Publication 305 Supplement 3 (covering the period 1971), and Special Publication 305 Supplement 4 (covering the period 1972) remain in effect. Two earlier lists, Circular 460 (Publications of the National Bureau of Standards, 1901 to June 1947) and its supplement (Supplementary List of Publications of the National Bureau of Standards, July 1, 1947 to June 30, 1957) are also still in effect.

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USCOMM-DC 29042-P74

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